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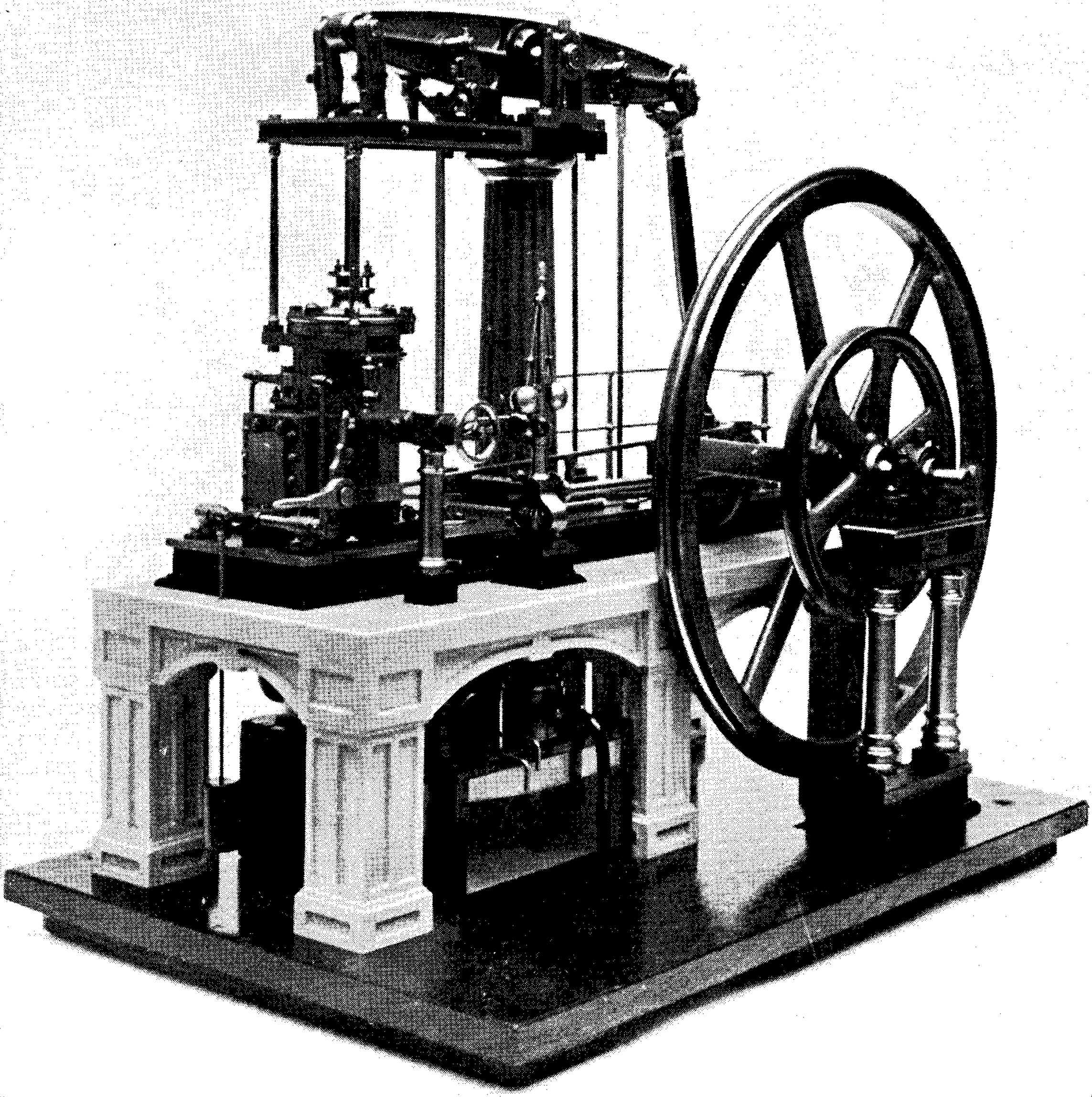
THE MODEL ENGINEER



The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

15TH MAY 1952 VOL. 106 NO. 2660

SMOKE RINGS

Our Cover Picture

● THE SINGLE-COLUMN beam engine illustrated this week is a model by Mr. H. Booth, of Bingley, Yorks, from a prototype built in Leeds in 1847. The details necessary for the construction of the model were obtained while the original was awaiting demolition.

Mr. Booth is of the opinion that the original engine had been rebuilt, because the cross-head and piston-rod were not fitted with the usual wedge and taper, but with taper and threaded end, drawn up by a large hexagonal nut.

The model shows the flywheel to be solid, but when the original engine was first made, the flywheel would be in two halves, held together on the central boss by two wrought-iron rings, with plates and wedges on the outer rim.

An Exceptional Model

● WE LEARN from Mr. L. A. Mitchell, of Harrow, that he and a friend have recently completed an interesting model which is exceptional in more ways than one. To begin with, the prototype is unique in the sense that it is the largest caisson sinking successfully undertaken in the world, with the aid of compressed air, and it is now under foundations of a cooling-water pumphouse for a generating station in South Wales; it was described in great detail in a paper recently presented to the Institution of Civil Engineers.

The model is, therefore, the only existing record of a very remarkable achievement; it is to a scale of 1/48, half of it being exposed framework, and half in concrete section. The framework was made up of something like 1,500 separate pieces of r.s.j., channels, tees and the like all machined from solid stock, on the lathe, exactly to scale. For this purpose, various jigs were made, and with their aid, it was possible to mill the sections at a rate of about 6 in. per minute; altogether, 600 ft. of this milling was executed.

The "concrete" section was composed of pieces of agglomerated cork of various sizes, painted natural cement colour and producing a very realistic effect.

The model stands on a baseplate 5 ft. 6 in. long by 3 ft. 6 in. wide, and we hope that it, together with the special jigs, will be exhibited at the forthcoming MODEL ENGINEER Exhibition. An added point of interest is that Mr. Mitchell and his friend are both keen builders of small locomotives and undertook to build this exceptional model in order to provide themselves with additional workshop equipment!

Others Have Had It, Too!

● FROM THE latest issue of *The N.Z. Model Railway Journal* we extract the following, without the customary acknowledgments, of course [!] :—

"Getting out a magazine is fun, but it's no picnic.

"If we print jokes, people say we are silly. If we don't they say we are too serious.

"If we clip things from other magazines, we are too lazy to write them ourselves. If we don't we are too fond of our own stuff.

"If we don't print contributions, we don't appreciate true genius. If we do print them, the page is filled with junk.

"Now, like as not, someone will say we swiped this from some other magazine. We did!"

London Trams' Finale

● FOR SEVERAL years it has been quite clear that the final disappearance of tramways from the London streets could not be long delayed. Some time ago, the announcement was made that the last trams would run on October 25th next; subsequently, this date has been brought forward to July 6th.

Many will regret the decision, partly for sentimental reasons and partly because of a firm opinion as to the utilitarian value of trams. Objection to the trams, however, is nothing new; as long ago as 1910 we heard the oft-repeated assertion, from all sections of the community, that the London streets were no place for light railways. That opinion, at long last, has won the day, and the trams are to be abandoned. The process of replacing the trams by omnibuses and trolleybuses has been proceeding for several years, and the general populace seems to have taken it for granted and accustomed itself to the changed conditions. All the same, after July 6th next, London will seem a strange place without *any* trams.

Model makers, however, have often taken the tram as a prototype, and we know of several very beautiful miniature trams. In recent years, we have noted a marked tendency for an increase in the interest in this subject, and we are expecting to see this increase maintained for a long time to come. After all, the fact that London and some other towns have decided that the tram is to be discontinued as a mode of public conveyance, does not mean that the tram is to disappear from every tramway system in the country. In fact, many of London's later types of trams are being sent to other cities where there is, as yet, no intention of scrapping tramways. Thus, they will continue in service, possibly in more convenient surroundings, for several years yet, and will still be available to model makers who might desire to try a hand at building a miniature tram.

The Tees-side Society's Exhibition

● THE TEES-SIDE Society's exhibition this year was held at the Holy Trinity School Hall, Stockton-on-Tees. It is believed that it is the first exhibition of its kind to be held in Stockton, traditional home of skilled engineering craftsmen, and was opened by Mr. J. H. Anderson, Principal of the Stockton Technical Institute, who paid a tribute to the model engineer and stated that the future of this country depended entirely upon the skill and craftsmanship of its people.

Among the 200 exhibits, were 27 steam locomotives of various gauges, 13 locomotives other than steam, 21 stationary engines, model ships, internal combustion engines, road locomotives, model cars and, last but not least, a very well arranged layout of tracks of various gauges, with stations, signals and many trains, all on a board 30 ft. by 18 ft., made up by members of the Small Scale Railways Group. This exhibit stole much of the attention of Stockton boys and their fathers.

Other exhibitors were the Tees Film Unit, members of which took films of the official opening and of the exhibits and also arranged regular film shows with topical films of larger size, the Tees-side Amateur Radio Club who demonstrated apparatus for the transmission and reception of amateur radio messages, and the International Radio-Controlled Models Society, Tyneside Group, who exhibited radio-controlled models. The attendance at the exhibition was regarded as being quite satisfactory, especially in view of the counter-attractions available during an unusually fine Easter week.

The "M.E." Aids Professional Engineers

● WHILE THE MODEL ENGINEER is chiefly concerned with the problems of the amateur craftsman and most of its subject matter is written from an angle which differs from that of the professional engineer, we know that it is extensively read in industrial circles, and many testimonials have been received from readers who have found it helpful in their professional career. The fact that production engineering is a very different matter from making a model in the home workshop, does not prevent general information on design and craftsmanship from being applied to production problems. The designs which are regularly published in THE MODEL ENGINEER are often found extremely helpful to junior draughtsmen in promoting their knowledge of general machine design and practical features of construction, while in other fields of engineering, the worker who encounters a problem slightly outside normal routine can often find help and guidance by reading the way problems have been tackled by amateurs with limited equipment. An example of such a testimonial has recently come to hand from a reader who states that for the past three years, he has been earning his living as a turner, and is now paid at the top rate in his present employment. He states, "Before starting turning as a means of livelihood my sole knowledge of lathes was gained from the pages of THE MODEL ENGINEER, and I may truthfully say that I have not yet been given a job which I have been unable to bring to a successful conclusion. I feel that this is entirely due to the guidance given in 'ours' and my thanks are due to THE MODEL ENGINEER for its excellent practical articles."

Mr. R. Lawton

● WE MUCH regret to learn of the death of Mr. R. Lawton, of Manchester, which occurred on April 25th. Mr. Lawton was chairman of the Radio-controlled Models Society and worked hard in the interests of the application of radio-control to models of various kinds. We recall his first interview with us on this subject, some seven years ago, when the possibilities of radio-control were discussed. We were able to assure him of our conviction that, provided that the co-operation of the Postmaster General could be obtained, radio-control had a great future, and we were ready at all times to support the idea.

Mr. Lawton was also vice-chairman of the Northern Association of Model Engineers as well as the leading spirit of the Association's annual exhibition. His untimely death removes an energetic enthusiast from the ranks of the model engineering fraternity and will be regretted by a wide circle of friends.

A REALISTIC ROUNDABOUT MODEL

by "Northerner"

(All photographs except No. 1, by the author)

ONE of the most realistic models it has ever been my good fortune to see is the $2\frac{1}{4}$-in. scale roundabout, built by Mr. H. Slack, of Chapel-en-le-Frith, Derbyshire. This magnificent model won the Myford Trophy for the best model of all in the 1952 exhibition of the Northern Association of Model Engineers, and in addition was awarded the Championship Cup in the "General Models" Section, and First Prize in Class 18, as well as Certificates of Merit for those awards.

On they gallop, in endless procession, in this fine $2\frac{1}{4}$-in. scale model roundabout

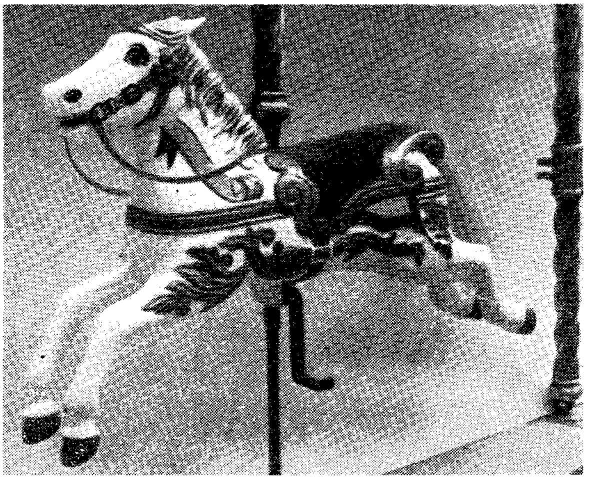
A Great Attraction

From this the reader will gather that the judges had a very high opinion indeed of the model! So, too, had the crowds who thronged the exhibition hall. Even when the machine was not running, the stand was surrounded with people, and when steam had been raised and the roundabout was in motion, the crowd was usually four or five rows deep. Undoubtedly Mr. Slack has captured the real fairground atmosphere : the brilliant, almost exotic, paintwork, the gleaming twisted brass rods, the galloping horses, the gesticulating figures on the organ, the carvings and the mouldings—all combined to give that elusive spirit without which a model can be dead, even though perfect in detail.

General Description

As already stated, the model is to $2\frac{1}{4}$-in. scale, and this brings the overall diameter to approximately 6 ft. 8 in. It is built in ten main sections instead of the more usual twelve—as Mr. Slack says, when he first started to build the model it was purely for his own amusement, and he had no thought of making an exhibition model. He therefore felt justified in saving himself some of the repetition work.

Each section can be dismantled correctly and quickly for ease of transport, and almost as quickly erected. There are three horses abreast in each section, and these, too, are correct in that the outermost horse is larger than the second one, which in turn is larger than the innermost one.



Close-up of one of the outermost horses, only needing its name to be painted to be complete

The model is built from Mr. Slack's own drawings throughout, these being the fruit of constant study and measuring-up of the prototypes on various fairgrounds.

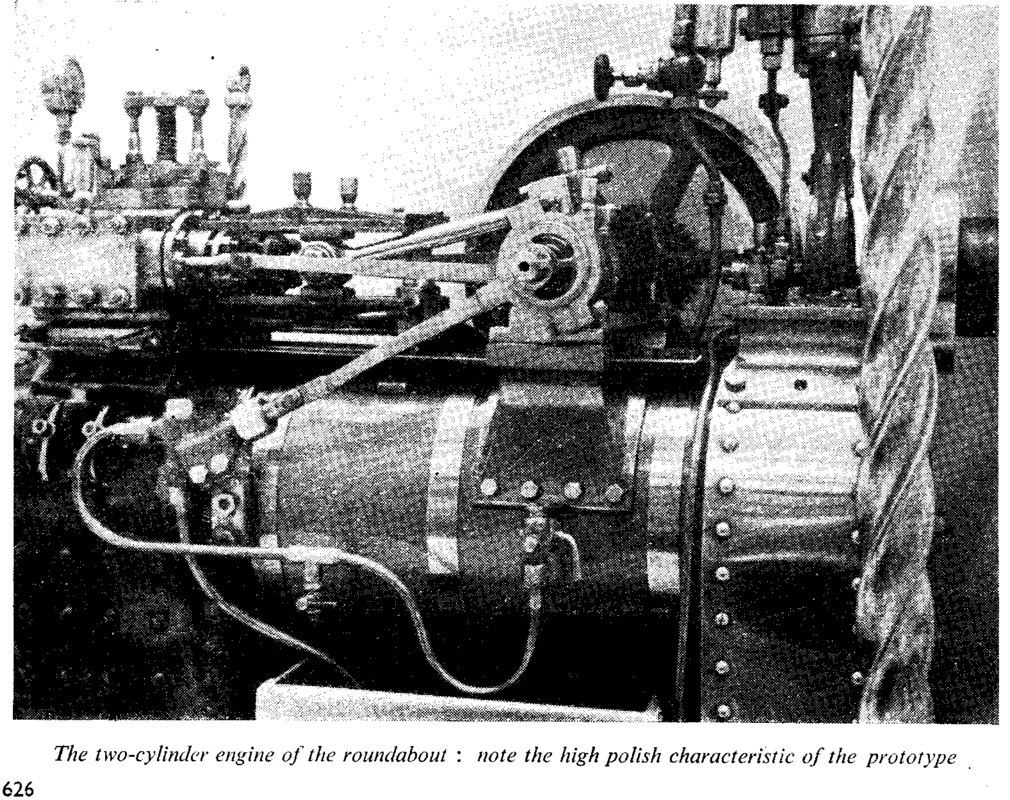
At the exhibition, the boiler was fired by calor-gas, and in previous running at home, before painting the model, it has been fired by coal-gas, although actually the boiler is designed for coal-firing.

Up to the present time, the leisure hours of approximately nine years have been spent on the model, and even now it is not entirely complete. For example, only the outer horses are fully painted, and in addition most of the other horses still lack their tails, their reins, and the velvet covering for their saddles.

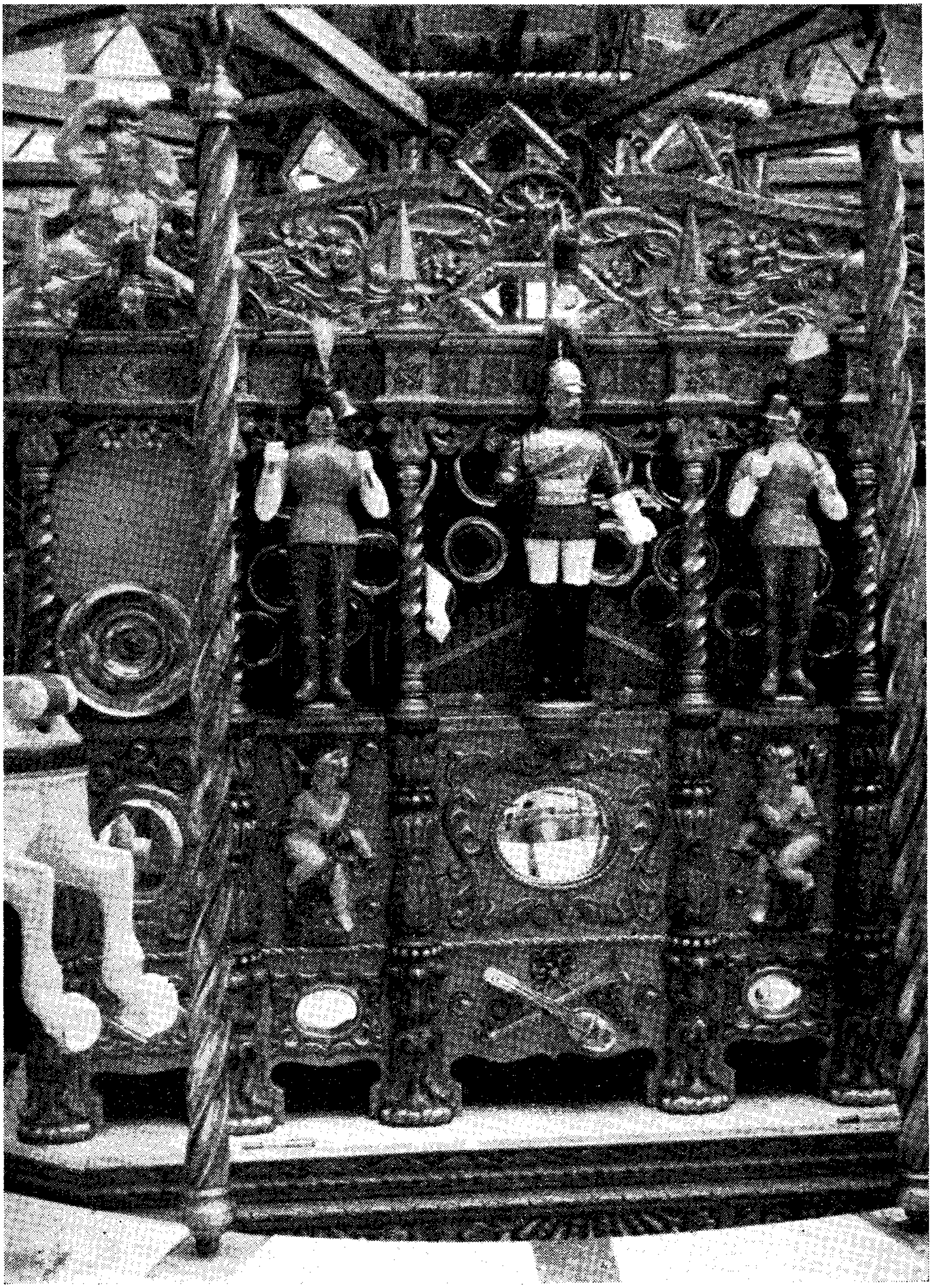
A loudspeaker is concealed behind the organ, so that appropriate fair-ground music can be played when the machine is running—which really completes the illusion. Unfortunately the amplifier had been damaged in bringing it to the hall, and so during the first day of the show the organ was perforce silent. On the Saturday and Sunday, however, "Entry of the Gladiators," and other typical tunes, added to the crowd's enjoyment of the model.

Constructional Details

The horses themselves are cast in aluminium, each being in six separate parts, namely: head, body, and four legs. Even in aluminium, the largest of the animals each weighs over 4 lb., the total weight of the horses being over a hundred-



The two-cylinder engine of the roundabout: note the high polish characteristic of the prototype



The magnificent detail and embellishment of the organ—does this take you back? Three of the horses were removed to allow this and other close-ups to be taken

weight. The patterns were carved by Mr. Slack himself, revealing him as no mean artist, incidentally, and this alone involved the carving of sixteen patterns—the apparent discrepancy being explained by the fact that the innermost horses have the same head and body as their immediate neighbours. But whereas the latters' legs are fully extended, the formers' are drawn in; otherwise they would not fit into the smaller circumference. By the way, all these patterns were carved from an old "mangle"-roller, using worn-down cobblers' knives—Mr. Slack is in the leather trade.

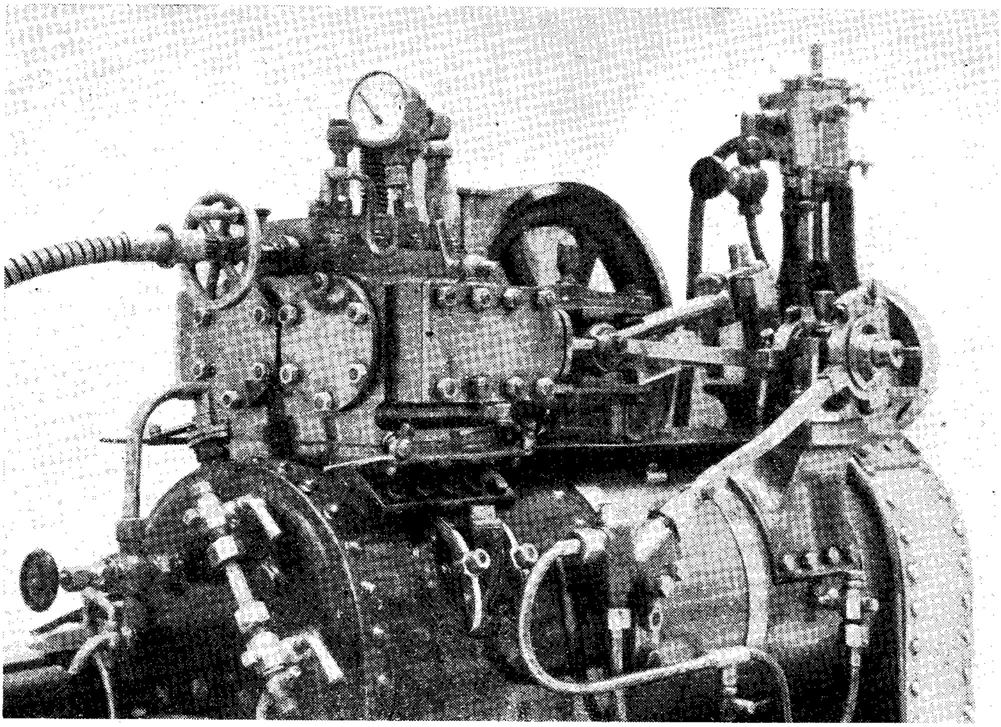
Commercial Items

After some trouble, the twisted brass for the stays was obtained from commercial sources, but it was very rough and the builder had to spend many hours in smoothing and polishing it.

Some of the wooden mouldings likewise were obtained commercially, but had to be fretted out, cleaned up, and fitted together. To fit in other spaces, however—notably round the lower edge of the canopy, between the mirrors—no suitable mouldings were available, and Mr. Slack decided to have a go at making them himself, successfully, as it turned out.

This was done by making a female die from a slab of brass, and forcing it into the surface of the wood under a leather-press. The die was made by carving the brass away with small chisels, and the resultant mouldings are as good as, or better, than the commercial article. They were finally fretted out and finished as before.

The numerous mirrors on the model were specially made locally; many of them are awkwardly shaped, and all have bevelled edges, so that making them was hardly a job for a layman.



Another view in which the high finish is apparent—those are reflections *and not shadows on the cylinder end! Note also the flexible control-rod for the regulator hand-wheel*

As part of the decorations on the organ, there are two female figures and two cupids. These were actually rescued from two Victorian photograph frames—they are cast-iron, and after cleaning-up and painting were just the job.

However, the three working figures on the front of the organ were carved by Mr. Slack himself. The central figure, a grenadier clad in gleaming breastplate, beats time, and the other two figures tinkle on a bell in the approved manner. The twisted painted columns separating the figures revolve, a large "jewel" on the top of two of them scintillating in the brilliant light.

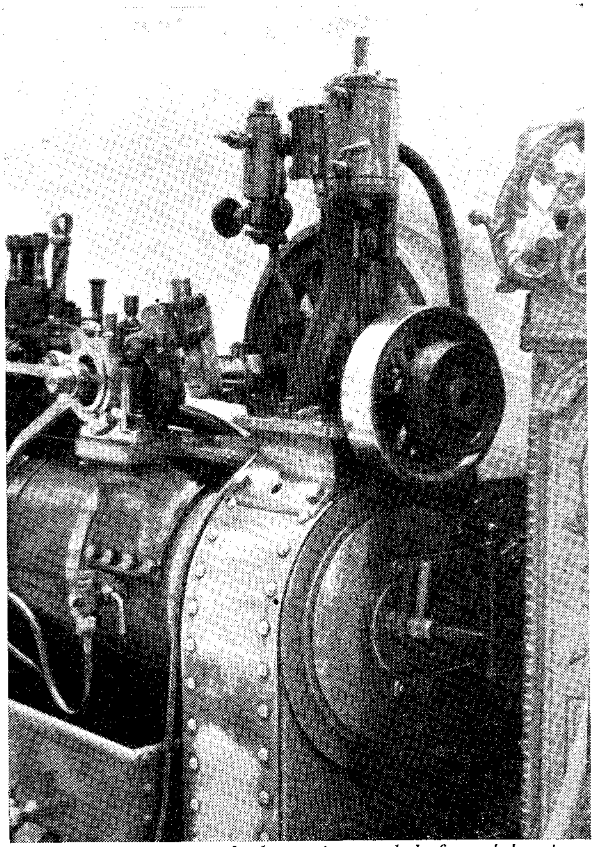
The Engines

The main engine is a close copy of the real thing. There are two high-pressure cylinders, $1\frac{1}{16}$-in. bore by 2-in. stroke, mounted on top of the loco-type boiler. Normal working-pressure is 60 p.s.i., but in actual practice the engine will easily start and run the heavy round-

about on 30 lb. Incidentally, the boiler was tested to 190 p.s.i., and apart from a few tiny weeps of the sort which soon "make-up," the test was entirely satisfactory. When running, the screw-down regulator is opened and closed by means of a flexible shaft which can be fixed to the boss of the hand-wheel, and which passes under the revolving platform to the outside.

The vertical organ engine is $\frac{3}{4}$ in. bore by $1\frac{1}{4}$ in. stroke, and is, of course, mounted on the smokebox. It drives the mechanism of the organ by means of a belt, which runs on a pulley integral with the flywheel.

Regarding the organ, the trumpets are made in brass: they were pressed in moulds from thin sheet, and are highly polished.



The organ-engine, and the main crankshaft and bearing-brackets

There are sixteen small electric lights on the front of the organ, and under the canopy are larger opal bulbs, which resemble the large opal globes frequently fitted to the prototype.

Paintwork

All the painting was done by Mr. Slack himself, and his steadiness of hand is apparent in every brush-stroke. It is a great pity that we cannot reproduce the photographs in colour, so that the reader can see the brilliance and realism for himself. Several different makes of paint were used; all the colours are semi-matt, but were varnished over to bring out the sparkle.

Before painting, the roundabout was run for many hours, and was then dismantled. There are, of course, a great number of hours represented in the painting, and the builder was out of bed until one or two a.m. on many successive nights in an attempt to complete it before the N.A.M.E. exhibition. Even so, as we have remarked, the painting was not entirely finished, but comparatively speaking there is not much more to do now.

Castings and Workshop

As with the horses, Mr. Slack made his own patterns, and the castings were made in a Stockport foundry. The engine and boiler are to the builder's own design, by the way. Of the gears, some, including the bevel-wheels driving the cranks which make the horses "gallop," were cut by the builder, but others were commercially obtained.

As for Mr. Slack's workshop, it will no doubt surprise many readers to learn that it contains only one machine. This is a treadle-driven *plain* lathe, which was itself built by Mr. Slack's father some forty or fifty years ago. All drilling was done in the lathe, or by hand. And since the lathe chucks are ancient and inaccurate, everything that has to run true has to be packed with shims in the jaws!

A Lesson

So perhaps there's a lesson here for some of the fraternity, who think that a well-equipped workshop—and a well-filled pocket!—are necessary for the hobby. For here were three cylinders to bore, and three pistons to fit, and two crankshafts to turn, and all done on a pedalled plain lathe! As well as tons of other accurate work, of course. But please spare us a shoal of letters from old-timers, telling of similar exploits in the past and present—all I want to do is to point out that these things *can* be done, if you have to, as this fine model roundabout proves.

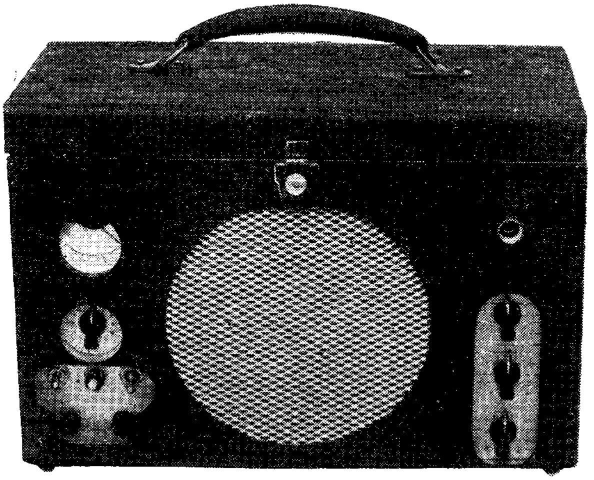
SURVIVING FAIRGROUND EQUIPMENT

Mr. W. Bennett, of Birmingham, has written to tell us that Pat Collins, of Gondola Works, Walsall, still has two fairground organs, one of which was recently seen with a set of galloping horses which at one time was steam driven. The same firm also possesses four road locomotives comprising a Foster scenic, two Burrells, one of which is a scenic, and a McLaren. Mr. Bennett says that all these are as good as new, and he is hoping to be able to take some photographs of at least one of the locomotives and one of the organs when the fair goes again to Birmingham.

A Portable Tape Recorder

With Notes on Magnetic Recording

by Raymond F. Stock



THE post-war years have seen a remarkable increase in the practice of non-professional sound recording : this is entirely due to the advent of magnetic recording apparatus.

The subject is not a new one since the principles were laid down many years ago, but the technique did not become generally recognised until recently, when magnetic recording media, both wire and tape, began to be commercially available.

Sound recording is an invaluable adjunct to amateur cinematography and dramatics, while domestically it permits one to copy disc records or to record radio programmes for replaying at a more convenient listening time ; apart, however, from these specific uses a recorder is a fascinating and entertaining social item—for most people a recording of their voice is still a novelty (not to say a shock !).

Hitherto the cost and complication of disc equipment has limited the use of sound recording to a very few keen amateurs ; magnetic recording brings the subject to a much wider field since it possesses the following advantages :

(1) The initial cost and bulk of the equipment is much reduced, and the apparatus is far easier to make, mechanically.

(2) Recordings, if required to be permanent, cost less than discs.

(3) If, as is usual, recordings are required for only a few playings, the running cost is negligible, as the same medium may be used over again, indefinitely.

(4) Continuous records of 30 min. are commonplace, and longer runs may be fairly simply arranged.

(5) Recordings do not depreciate with playing in the way discs do, and storage space required is small.

To offset the above advantages magnetic recording displays one great drawback—duplication of a recording, or reproduction on a commercial scale is uneconomical ; but, happily, this is one disadvantage that hardly affects the amateur.

There are two current media for magnetic recording—wire and tape, though for dictaphone purposes, recording is also done on magnetic discs and belts. This article deals solely with the use of tape, though the principles apply equally to the other systems with obvious differences in the methods of mechanical handling.

Commercial tape consists of a paper or plastic base 3 or 4 thou. thick and 0.25 in. wide, coated on one side with a varnish containing a finely divided magnetic oxide of iron in particle form. It is commonly purchased in 1,200 ft. lengths, wound on 7 in. aluminium reels, at a cost of 25 to 30 shillings a reel. This, at the normal running speed of $7\frac{1}{2}$ in. per second is more than sufficient for a half hour's recording, and greater or smaller quantities may be handled on reels of different diameter ; a 5 in. reel holds sufficient for 15 min. Standard 8 mm. cine reels are generally employed to hold the tape.

Principle

Fig. 1 illustrates the method of recording. A conventional microphone and amplifier are used to feed an audio signal to the recording head, which consists of a coil of wire wound upon a ring-shaped core (of magnetic material) having a narrow gap in one face. The tape is drawn at a constant speed across this face. The fluctuating current in the coil produces a similarly varying magnetic flux through the core and this is concentrated at the gap where it causes corresponding magnetic changes, of a permanent nature, in the tape coating.

On completion of a recording the tape is thus magnetised throughout its length to a continuously varying degree.

The tape is then rewound, end for end, and for replaying purposes it must again be drawn across the head in the same direction and at the same speed as in recording ; this time, however,

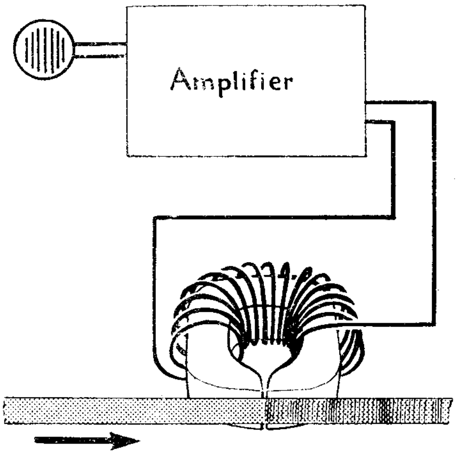


Fig. 1. *Recording*

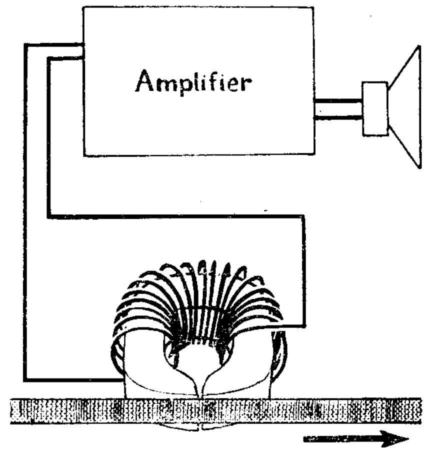


Fig. 2. *Reproducing*

the head is connected to the amplifier input and a speaker is wired to the output (Fig. 2).

Now as the tape is drawn across the head, its own varying magnetic condition produces similar changes in the flux through the core, and these induce minute voltages in the coil, which, suitably amplified, drive the loud speaker and thus reproduce, more or less, the original sounds impinging on the microphone.

It is evident that in order to obtain a good reproduction of the original sounds the magnetic changes in the tape must correspond closely with the varying magnetic flux in the head which produces them. In fact these two quantities are linked by a curved graph, but there is a sufficiently straight portion which may be used given the correct arrangements. To operate the tape upon the linear portion of its curve requires that it be "biassed" magnetically to the correct point; this effect is analogous to the biassing of an amplifying valve to work on the straight part of its characteristic curve.

Magnetic bias may be applied to the tape by subjecting it to a magnetic field of suitable strength, quite independent of the audio signal. This might be applied with a permanent magnet or d.c. electromagnet as is in fact done in simple equipment, or in Service equipment, where reliability is of paramount importance; it does, however, leave an unpleasant hiss upon the tape and the normal expedient is to use an alternating magnetic field of relatively high frequency. Generally a frequency of about 30 to 40 kilocycles/second is used, the exact value not being critical. This a.c. is produced by a simple valve oscillator and fed into the common head winding through a condenser.

In order to take advantage of the greatest virtue of tape it is necessary to provide a means of erasing recordings. This can be done by passing the tape over a permanent magnet, but while quite satisfactorily removing previous recordings, this technique again leaves a hiss upon the tape. Consequently it is usual to

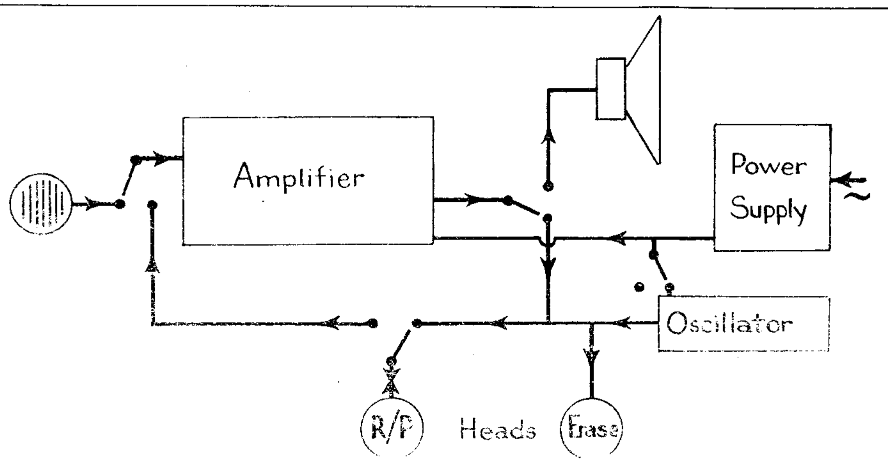


Fig. 3. *Schematic layout of recorder, set to "Record"*

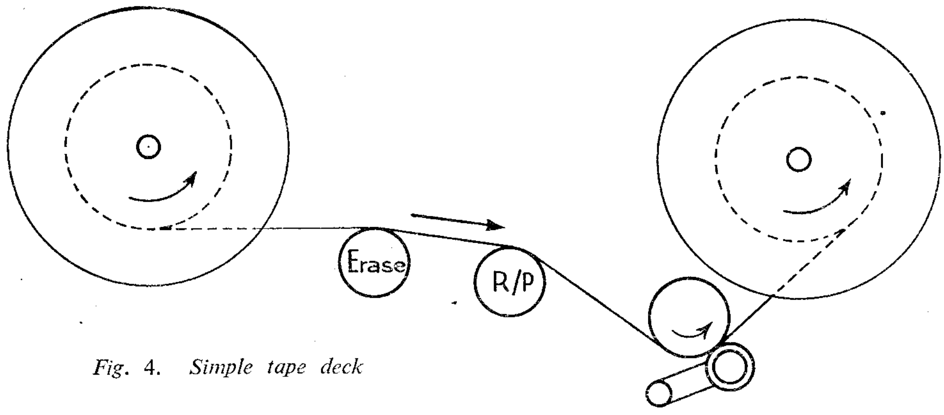


Fig. 4. Simple tape deck

pass the tape through an alternating magnetic field and this is provided by the erase head, a device similar to the record head, but fed with pure a.c. of a supersonic frequency. The frequency used is even less critical than that for the bias, but conveniently the same oscillator is used.

It is common practice to erase one recording while another is being made, the tape passing over the erase and record heads, in that order, these units being spaced only a few inches apart. Unless separate record and playback heads are in use (as in the highest class equipment) the common Record/Playback Head must be switched between input and output of the amplifier.

The microphone and speaker must be switched into the input and output during record and playback, respectively, and neither bias nor erase power is required during playback. Switching is employed to produce these correct combinations of units, so that the complete outfit is as shown in the block schematic diagram Fig. 3.

The actual electronic arrangements follow the schematic diagram quite closely and a conventional amplifier and power pack are used. The oscillator is a simple one-valve circuit, and in fact the electronic gear may be regarded as quite straightforward.

Certain components are required between the output of the amplifier and the head during recording and these are described later. To increase the utility of the machine it is common practice to fit an input socket instead of wiring directly to the microphone so that one may then accept a signal from any source such as a radio tuner unit or a gramophone pick-up or even a photo-electric cell. The latter might be employed to use the machine as a timer since the tape could give a direct comparison between a constant time signal and any incoming marker signal; alternatively the tape can be calibrated visually throughout its length.

Mechanics of Tape Handling

The electronic gear is fairly simple, and varies only with the quality of the components and the refinements of the circuits; the mechanical side of the apparatus, however, gives a wide scope for individual preference.

The main requirements are simple; during recording or playback the tape must be drawn across the head at a constant velocity; the absolute speed is of less consequence except where the recorder is required to accept tape recorded on another machine or vice versa, when obviously both recorders must run at the same speed.

During rewind, between recording and playback, the tape must be wound back to the beginning as fast as possible.

Since recording tape is not perforated in any way (as yet) handling must be by friction alone, and only one method of propelling it is used. The tape is passed around more or less of the periphery of a capstan (driven by an electric motor) and held against the capstan by a spring loaded roller in order to provide sufficient frictional grip. This combination of capstan and pressure roller draws the tape from the full reel (known as the rewind reel) across the surface of the erase and record heads. Issuing from the capstan the tape is then taken up by another reel—the take-up reel—which is motor driven via a slipping clutch so that even at the beginning of a recording when its effective diameter is least it always tends to overwind. This arrangement is shown in Fig. 4.

At the termination of a recording the tape must be passed from the take-up to the rewind reel and this is done by freeing it from the capstan and heads and motorising the rewind reel shaft. All the apparatus associated with the described functions is collectively known as the "deck" and is analogous to the motor-board of a radiogram.

In order to produce a constant tape velocity the following points must be observed:

(1) The take-up reel must not over-ride the capstan and "snatch" the tape forwards.

(2) The rewind reel in rotating must not impose so much loading on the tape that it lags backwards.

(3) The capstan must be truly circular and concentric with its bearing(s).

(4) The capstan must be driven at a constant r.p.m.

(1) and (2) are dealt with by adjusting manually the friction between the rewind reel and its shaft, and between the take-up reel and its shaft

(unless a separate friction clutch is incorporated in the shaft when adjustment is carried out on the latter).

(3) is a matter of good workmanship and ;

(4) less easy to attain, demands the use of either a well-governed or a constant speed motor.

In a studio quality recorder where cost and space are of less consequence it is usual to employ three separate motors—one each to the rewind and take up shafts and one driving the capstan. The capstan drive may be quite complicated, one method being shown in Fig. 5 where a governed motor is seen driving a layshaft which rotates the capstan via spiral gears. The capstan is heavily damped by a flywheel and any short term variation in the speed of the motor is lost by an axial movement of the layshaft, caused by the action of the spiral gears. This axial movement is then damped by a dash-pot.

At the other end of the scale one may mount a capstan (and integral flywheel) on the shaft of a standard governed electric gramophone motor, in which case the flywheel should have about the same momentum as the discarded turntable.

If a.c. mains are available one may use a simple rim drive gramophone motor (shaded-pole type is usual) and friction-drive the flywheel. These are some of the obvious alternatives to an interesting problem.

In the simplest equipment the capstan motor may be switched over, by a mechanical clutch, to driving the rewind reel during rewind. It is, however, usually more convenient (and easier) to provide a second motor for this function, and here almost any type of motor of sufficient power will serve. A small commutator motor would do well, preferably series-wound, as this type gives a high starting torque. Sparking from the brushes would not matter since the amplifier is not used during rewind. If sufficient torque were available the rewind reel could be mounted directly on the motor shaft.

The take-up reel can be driven by a spring belt (as in cine apparatus) from the capstan and this is satisfactory provided the capstan motor is powerful enough. It should be remembered that tape take-up provides a varying load and this can reflect on the speed of the capstan if the drive motor does not have adequate power. In high quality apparatus a small shaded pole motor is used directly or via step down frictional "gearing" to provide rotation of this shaft.

The straightforward arrangement of parts in Fig. 4 is often inconvenient and a more compact deck is obtained by grouping the reels together

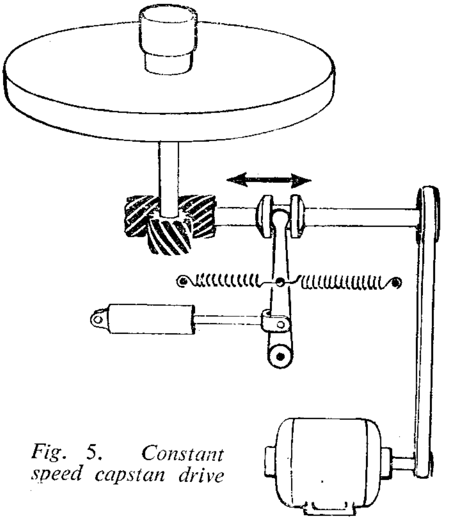


Fig. 5. Constant speed capstan drive

with the heads and capstan below them. This entails the use of tape guides which may be free running rollers but (to eliminate a source of noise) are usually fixed pillars chromed to present a hard shiny surface to the tape.

It is desirable to pass the coated side of the tape over as few components as possible, and in any case all magnetic materials such as iron and nickel alloys should be excluded from tape-deck fittings.

Tape may be wound with the coated side inwards or outwards to suit the layout of the machine. The recorder described later uses the latter arrangement and it will be seen that the coating touches only the heads and the pressure roller (which is of rubber).

(*To be continued*)

A Vauxhall in Miniature

We have received from Messrs. Victory Industries (Surrey) Ltd., Guildford, Surrey, a working model of the Vauxhall Velox to 1/18 scale.

Powered by the well-known "Mighty Midget" electric motor, this little scale replica, which is being mass-produced by Messrs. Victory Industries in collaboration with Vauxhall Motors Ltd., Luton, has a most realistic appearance. On test, we were astounded by its climbing power and, on a flat surface, the way it will traverse an identical circuit for an indefinite period. Drive is taken from one wheel only, the other running free and thus affording a differential action. The front axle is centrally pivoted to ensure that all wheels remain in contact with the running surface, and the steering linkage is on the Ackerman principle.

A forward, stop and reverse switch is fitted adjacent to the offside chassis member.

Although, as supplied, these models represent a highly accurate general impression and possess the undoubted atmosphere of the prototype, the model engineer with a keen eye for detail work could undoubtedly do a great deal to perfect the realism of the internal and external fittings. To clarify this statement, we would point out that we are fully aware of the barriers which render the production of detailed scale models by the trade an uneconomical proposition, and we make this observation purely in the interest of those of our readers who may be in search of a basically accurate model, upon which to add further details.

NOTES ON PROPELLER TESTING

by S. G. Dreier

WHILST appreciating the efforts of Mr. Raxworthy in his article published last year to obtain a better idea of the performance of model screw propellers, I feel that there are quite a few points that he has not appreciated with respect to such a complex problem as screw propulsion.

It is true that his method does give a comparison between screws of similar type but to a very inaccurate degree ; a fact that has not been taken into account and a very important one at that, is that the propeller under test is working under conditions of 100 per cent. slip, i.e. it is running in still water, whereas under working conditions it is in moving water or in other words, the wake of the vessel.

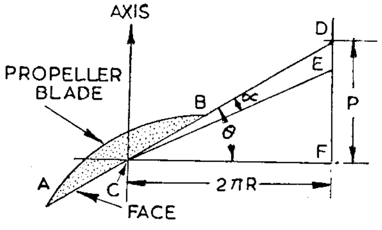
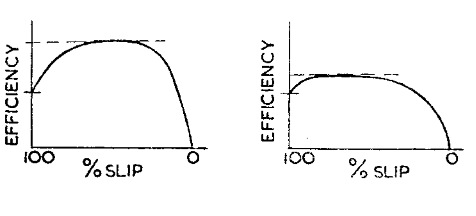


Fig. 1

The slip of a propeller is the difference between the product of r.p.m. and pitch ($= P \times N$), and its advance in the direction of its axis in time expressed as a percentage of $P \times N$, this advance can be measured in terms of ship speed, water speed or thrusting speed of the screw. The slip is given by the expression $\dfrac{P \times N - V_1 \times 101.3}{PN}$ where V_1 is the advance through the wake water ; this is shown graphically in Fig. 1. Where θ = pitch angle from $\tan\theta = \dfrac{P}{2\pi R}$ where P = pitch R = radius. EF is equal to $\dfrac{V_1 \times 101.3}{N}$ or the advance of the propeller through the wake per revolution, and the distance DE is the slip per revolution, the angle DCE is the slip angle.

Although two screws may have the same apparent efficiency at a figure of 100 per cent. slip, under working conditions in moving water their efficiencies may differ greatly, as shown graphically in Fig. 2.

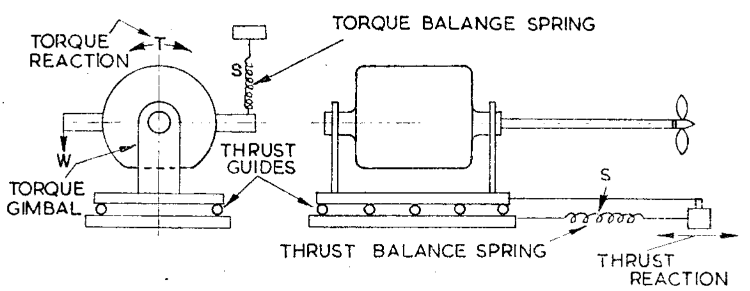
Efficiency has been plotted against per cent. slip, and it can be seen in Fig. 2(a) that maximum efficiency occurs at about 30 per cent. slip ; this is also true in Fig. 2(b) but to a lesser value of efficiency, the values at 100 per cent. slip are identical.



(*a*) (*b*)

Fig. 2

It is customary when testing propellers to have them working in moving water so that some semblance of working conditions is simulated ; the speed of the water should be equal to the speed of the propelled vessel. This can be done simply by placing a subsidiary tank above the testing tunnel, thus giving a head of water which can be released at known rate past the screw under test. It is for this purpose that the manometer or Pitot head shown in the article by Mr. Raxworthy should be used, i.e. for measuring the velocity of the water through the tunnel ; placed in the position shown in the article, the manometer will not give a true indication of the



(*a*) (*b*)

Fig. 3

(*Continued on page* 638)

"Britannia" in $3\frac{1}{2}$-in. Gauge

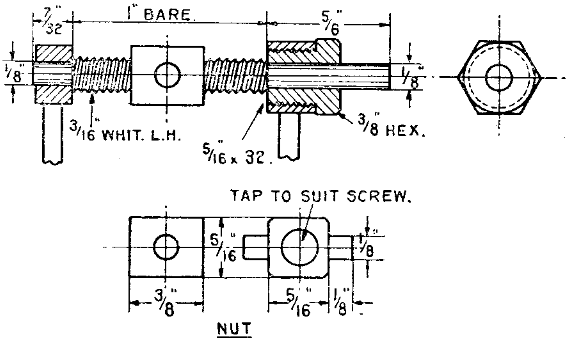
by "L.B.S.C."

Details of the Reversing Screw

WHEN describing the left-hand motion bracket for *Britannia* I mentioned that I didn't know whether our approved advertisers would be able to manage castings for it. That remark "stirred up their coffee," in a manner of speaking. The first response came from Angus Mc. Wilwau, the laddie who hails from the land of bagpipes, bawbees, and braw bonnie lassies. If he could make a pattern for, and cast, those same lassies riding horses, he wasna gaun tae let a wee bracket beat him, ye ken; and he promptly made a pattern and forwarded a sample casting. That was two days ago, time of writing; I don't expect the others will let him get away with it! I have also received from Bro. Reevesco, of Baernegum, some of the cleanest castings for stays, bogie, etc., that I have ever seen; they look like die castings, but are in iron. He also sent samples of cast malleable connecting- and coupling-rods, which are a boon to those builders with limited equipment, as they only need cleaning with a file. Kennion Bros. have also sent one of their new injectors made to my specifications, and I'll report on this as soon as I have given it a test, same as my own.

Resuming business, the next job is to fit the reversing screw to the bracket. The job is done in the same way, whether the bracket is cast, or built up. First centre the smaller boss, and drill it No. 32, taking precautions to keep the hole quite parallel with the bolting flange; if cockeyed, the screw will bind. Then drill the larger one, same size, using the method suggested for keeping the link trunnion holes in line. Open out the hole to 9/32 in. diameter, or use letter J drill if you have it; tap $\frac{5}{16}$ in. $\times$ 32, and make a gland fitting to suit, just like a piston gland or spindle gland. Use $\frac{3}{8}$-in. hexagon rod for this, bronze for preference, and drill it No. 32. Screw it home, and then put a $\frac{1}{8}$-in. parallel reamer through both bearings, to ensure them being dead in line.

The screw itself can be made from $\frac{3}{16}$-in. round mild-steel, as the wear on it is negligible; but if you fancy silver-steel, why, go right ahead and use it. Chuck in three-jaw, and turn down 7/32 in. of the end, to $\frac{1}{8}$ in. diameter, a nice running fit in the bearing on the bracket. Aim for the smoothest possible finish. Now pull the rod out of the chuck until there is about $1\frac{1}{4}$ in. showing between shoulder and chuck. Screw a full 1 in. with $\frac{3}{16}$ in. left-hand Whitworth thread; use a tailstock die-holder, and make sure that the chuck is screwed on very tightly, for if the so-and-so comes loose whilst you are operating, as it will do, if not tight, when cutting left-hand threads, the job will be cattled, and provoke some railroad Esperanto. If you haven't any left-hand taps and dies, right-hand will do at a pinch; but in that case, the engine will go the opposite way to the rotation of the reversing wheel in the cab. It would astonish the good lady quite a lot, if the freshly-washed clothes shot back at her when she turned the wringer wheel in the usual direction!



Reversing screw and nut

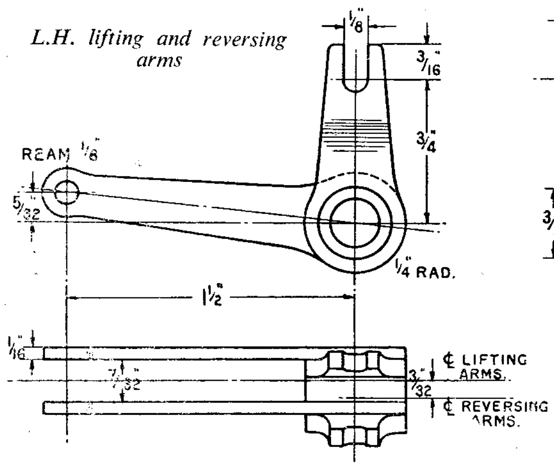
I am specifying ordinary Whitworth thread, for ease of manufacture, although the big engines have two-start Acme threads, and this will be found to answer quite well; but there is, of course, not the slightest objection to anybody who possesses the skill, patience, and equipment for cutting a small replica of the full-size screw, making and fitting that pattern. Personally, I'm not taking that much trouble; the left-hand Whitworth thread will do all that Curly requires.

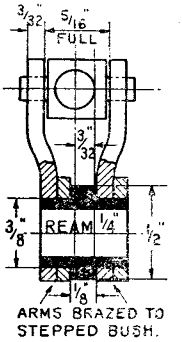
After the screwing operation, pull the rod out of the chuck a little farther, and part off at $1\frac{5}{8}$ in. from the shoulder. Reverse in chuck, and don't screw the jaws up tightly enough to damage the thread; then turn a full $\frac{5}{8}$ in. length to $\frac{1}{8}$ in. diameter, to fit the gland, as shown in the illustration. This should also be a nice running fit, and perfectly smooth. When assembled, the screw should turn freely, but should have no endplay. A universal joint goes on the projecting end of the spindle, but we'll see about that when we come to the wheel and bevel gear in the cab.

Reversing Nut

As there is hardly enough room at the sides of the tapped hole in the reversing nut, for separately screwed-in trunnion pins, it would be best to make the lot in one piece. This is easy enough. The best stuff to use would be good hard bronze, but steel will do quite well. A

L.H. lifting and reversing arms





arm, from $\frac{1}{2}$-in. × 3/32-in. steel. Drill No. 32 holes at $\frac{3}{4}$ in. centres, and open out the holes in the larger ends, to $\frac{3}{8}$ in., by using 23/64-in. drill and $\frac{3}{8}$-in. parallel reamer. Ream the others $\frac{1}{8}$ in., and carefully saw down to them from the top, finishing with a file, or slot them in the lathe, or on a milling machine, as described for valve-gear forks. Don't bend yet. Chuck a bit of $\frac{1}{2}$-in. round steel rod in three-jaw; face, centre, and drill to $\frac{1}{2}$ in. depth, with letter C or 15/64-in. drill. Turn down 5/32 in. of the end, to a tight fit in the $\frac{3}{8}$-in. holes in the reversing and lifting arms. Part off at a full $\frac{7}{16}$ in. from the end; reverse in chuck, and turn down 5/32 in. of the other end likewise, leaving a $\frac{1}{8}$-in. collar, $\frac{1}{2}$ in. diameter, in the middle. Poke a $\frac{1}{4}$-in. parallel reamer through. That settles the combined gadget's boss; for the right-hand lifting arm, proceed in similar fashion, but make it only 11/32 in. overall width, with a $\frac{1}{16}$-in. step at each side, and a 7/32-in. collar in the middle, as shown in the sectional illustration.

On the full-sized engine, the centre-line of the reversing screw is offset approximately $1\frac{1}{2}$ in. from the centre-line of the expansion link, which naturally throws the centre of the lifting arms over, to the same amount. This comes out at 3/32 in. on our small edition, and we can get it without any trouble, by assembling all the arms

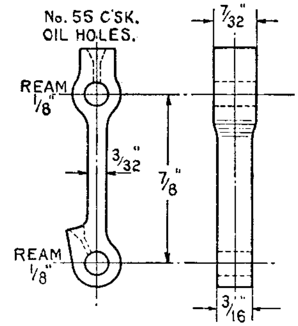
piece of $\frac{3}{8}$ in. × $\frac{5}{16}$ in., or $\frac{3}{8}$ in. square, could be pressed into service. Chuck truly in four-jaw, face the end, and turn down the end to $\frac{1}{8}$ in. diameter for $\frac{1}{8}$-in length. Part off at a full $\frac{7}{16}$ in. from the shoulder. Reverse in chuck; if you slack two jaws, and re-tighten the same two, the piece should still run truly. Turn down $\frac{1}{8}$ in. of the end to $\frac{1}{8}$ in. diameter as before. Now chuck truly in the four-jaw, endwise; hold tightly with top and bottom jaws only, using the two at the side, just pressing against the pins, to keep the nut central. Centre the end, drill through with 9/64 in. or No. 27 drill, and tap $\frac{3}{16}$ in. Whitworth to suit the screw.

An alternative way to make the nut, would be to part off a $\frac{3}{8}$ in. length of $\frac{5}{16}$ in. square rod, and drill a $\frac{1}{8}$-in. hole through the middle, starting from one of the wide facets. Be sure it goes through dead square! Countersink both sides, drive a $\frac{9}{16}$ in. length of $\frac{1}{8}$-in. round steel through, so that $\frac{1}{8}$ in. projects each side, and fill up the countersinks with silver-solder. If you get any on the pins, chuck in three-jaw by the opposite pin, and skim off the surplus with a knife tool, taking care to avoid cutting the pin; or a small fine file could be used. Then drill and tap the hole for the screw, as above, which will automatically cut away the surplus bit of pin in the centre of the nut.

Combined Lifting and Reversing Arm

On the full-sized engine, this component is made from a forging or stamping, all in one piece. On the little one, it *could* be machined from a solid block, or even cut from solid with hacksaw, files, and oodles of elbow-grease, not to mention patience. However, there is no need for either, because the whole doings can easily be built up as shown. Might as well make the right-hand arm whilst on the job, so cut out four pieces, to the shape shown in the side view of the right-hand lifting arm. Strip steel of $\frac{1}{2}$ in. × $\frac{1}{16}$ in. section can be used, or $\frac{1}{16}$-in. bright plate. Drill the holes at the small ends No. 32, for a kick-off. All four arms are left straight, as shown in the plan views.

Next, cut the two parts forming the reversing



Lifting link

on the boss, as shown in the part cross section, and setting out the upper ends of the reversing arms, to just the right amount to fit over the nut. It is just a matter of careful bending. Looking at the assembly from the back, the outer step of the boss has the lifting arm next the shoulder, and the reversing arm outside it. On the inner step, the reversing arm is next the shoulder, and the lifting arm on the outside. Assemble them thus, but don't attempt any bending yet; just

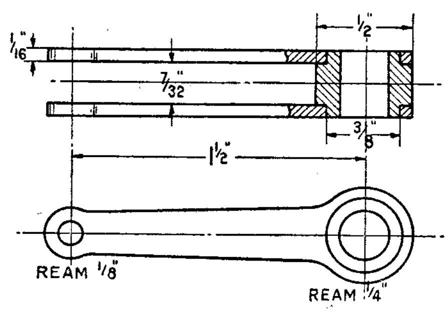
set the arms at the correct angle, as shown in the side view. The eye to which the lifting link is attached, should be 5/32 in. above the horizontal line, when the reversing arm is exactly vertical.

Both side members of the reversing arm and lifting arm should, of course, be absolutely dead parallel; and this can be checked by putting the No. 32 drill through the eyes at the end of the lifting arm, and a bit of $\frac{1}{8}$ in. flat bar in both slots of the reversing arm. When O.K. anoint the joints at the boss with some wet flux, and either braze or silver-solder the lot, as per the instructions previously given for other small jobs; jewellery work, I call it.

Quench the job in clean water, when the redness has died away; carefully clean it up, and then bend the upper parts of the reversing arm, as shown in the cross section. It only needs a pair of pliers and a little gumption. The reversing nut should fit nicely as shown, the trunnions going into the slots, and the nut having no appreciable shake between the jaws of the reversing arm. The right-hand merchant can then be finished off in the same way, and will be just a piece of cake, after the "combined operations" gadget. Finally, put a $\frac{1}{8}$-in. parallel reamer through the eyes at the ends of both lifting arms, and a $\frac{1}{4}$-in. reamer through the bosses, in case they have become scaled and distorted.

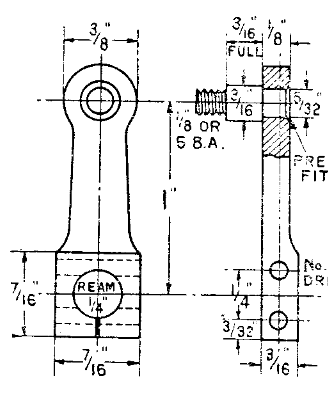
Lifting Links

In order to please Inspector Meticulous, I have shown a lifting link of the same shape as that on the full-size engines. The two of them, one for each side of the engine, can be either filed up, or milled, according to the facilities available, from $\frac{1}{4}$-in. square steel. Ordinary mild-steel will do. The full-size ones are bronze-bushed, but there is no need to bother about this on the little one; if they eventually show signs of wear, at some future time—which is unlikely, with properly-fitted silver-steel pins; my old *Ayesha* was supposed to fall to pieces in a week!—it is only a few minutes' work to run a drill



R.H. lifting arm

through the worn holes, and put bushes in. Mark them out as shown, drill the holes No. 32, file or mill to the given shape and dimensions, and finally put a $\frac{1}{8}$-in. parallel reamer through the holes. The big ones have brass caps to the oil holes, but here again, they are unnecessary in $3\frac{1}{2}$-in. gauge, the countersunk holes doing the



Return crank

needful. A sound film, or television picture, of what I call a "scale fanatic," getting the screw caps out with a weeny-weeny spanner, filling up the oil receptacles, dropping both caps when trying to replace them, and searching for same among grass, earth, or dusty concrete or tarmac, to the accompaniment of a good flow of railroad Esperanto, would be a source of unholy delight to old Curly, my few personal friends, and many of the good folk who find a little amusement, as well as instruction, in these notes!

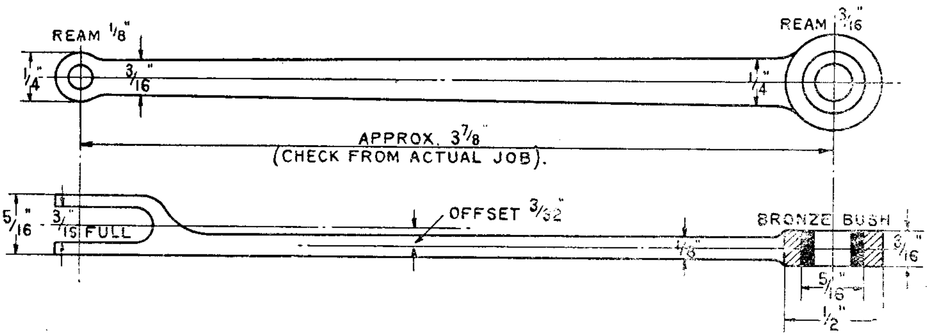
Return Cranks

Making the return cranks, is another simple job calling for no special instructions. They can be milled, or sawn and filed, from $\frac{7}{16}$-in. $\times$ $\frac{3}{16}$-in. steel bar, or the nearest available size larger. The illustrations give all the necessary dimensions. Drill the hole in the rounded end with No. 23 drill, and ream it 5/32 in., as plain drilled holes often come out oversize except at the end, where a little ridge is left that usually foxes the locomotive builder when he tries to turn a pin to a press fit. Countersink the hole on the relieved side of the crank. Turn the pin from $\frac{3}{16}$-in. round silver-steel, leaving the "natural" finish on the journal part. Put a nut on the thread to protect it when pressing the pin home; rivet the end into the countersink, and file off flush, and it will never shift during the lifetime of the engine.

Two No. 43 holes are drilled through the thickness of the square boss, for 8-B.A. locking bolts. These bolts cut into the end of the crank-pin, and prevent the return crank from turning on the pin, once it is correctly set. When drilling them, put a bit of $\frac{1}{4}$-in. round rod in the hole, so that the drill goes through solid metal all the way, and has no chance to wander; remove when through, and make a fine sawcut from the bottom of the boss, into the hole, as shown.

Eccentric-rods

I have given a drawing of the eccentric-rods here, so as to complete the list of "pictures," but don't make it—or at least don't finish it off to length between centres—until the valve-gear is erected, *as the actual exact distance between centres, must be obtained from the engine herself.*



Eccentric-rod

That is, if you want her to come up to the "Curly guarantee." If all goes well, the erection of the gear will form the subject of the next instalment of this serial. Meantime, I might call attention to the fact that the return crankpin end, on the big engine, contains a double-row self-aligning ball-bearing ; and I don't think that these can be obtained in a size small enough to fit our weeny gadget. If anybody has a couple that would suit, by all means fit them ; I haven't, so am using plain bronze-bushed ends, as shown in the drawing. I have considerable faith in bronze bushes, considering that the sample sent to me by that master-craftsman lathe-maker, the late J. W. Milnes, lasted at the tail end of the mandrel on my "type R," for a matter of 23 years—and it was only sent to prevent the machine lying idle whilst he made a new reversed-cone hardened steel bearing, to replace the original roller-bearing, which caused minute ridges on faced work. I wouldn't change that lathe for ANY similar-sized machine on the market today !

After the erecting instructions have appeared, and you have set your return cranks correctly, and obtained the exact length of the eccentric-rod as will be explained, it can be made as per the illustration, using the same methods as for combination lever and other forked rods. Mild-steel of $\frac{1}{2}$ in. $\times$ $\frac{3}{8}$ in. section will be needed, unless the big circular boss is made separately and brazed on—quite in order for a $3\frac{1}{2}$-in. gauge job—in which case $\frac{5}{16}$-in. $\times$ $\frac{1}{4}$-in. steel would do ; and with that, I'll wish you farewell for another week.

Notes on Propeller Testing

(*Continued from page* 634)

velocity through the tube, as the flow varies across the area of the tube being a maximum at the centre, the outside being affected by the proximity of the tube wall. A better method is to have several Pitot heads round the circumference, leading to a common measuring manometer or "U" tube ; in this way the errors are averaged out and a mean result obtained.

The so-called damper plate itself introduces considerable error in measurement, as it restricts the flow through the tube and will give a different set of results for each of its points of balance, due to the changed conditions at the screw ; if the system is left in operation until the displaced water gets back to the main tank along the return tubes, the results will again be unstable.

The only really accurate method of measuring torque and thrust, which are the important results, is to do it at the motor end of the shaft by means of a dynamometer. This can be done by mounting the motor complete in gymbals and balancing the torque about the axis of the shaft by means of weights or spring balances as in Fig. 3(a) ; the thrust of the screw can be measured by mounting the motor unit complete on guides and ball-races so that the thrust moves the unit along the shaft axis, and balancing this in a similar manner to the torque. (Fig. 3(b).)

The results to be obtained with apparatus outlined above will be within a few per cent. of complete accuracy ; without being too critical, I would hazard a guess that Mr. Raxworthy's set-up, while giving a basis to work from, would be about 50 per cent. accurate.

The tunnel section itself can be a length of 3 in. diameter glass tube glanded into the other sections of the testing tank, so that the screw may be observed whilst tests are being carried out. It should be pointed out that the apparatus should be run minus the test propeller, but with a dummy boss and fairing cone first, and torque measurements taken ; this will account for "idling" losses such as drag in bearings and water friction on the shaft, these should be deducted from the final results for good accuracy.

I trust that these points will be of help to others who may be contemplating the construction of a similar test unit ; I shall be glad to add to them if necessary through the Editor of THE MODEL ENGINEER.

IN THE WORKSHOP

by "Duplex"

No. 115.—Fitting an Electric Motor to the Tailstock Drilling Spindle

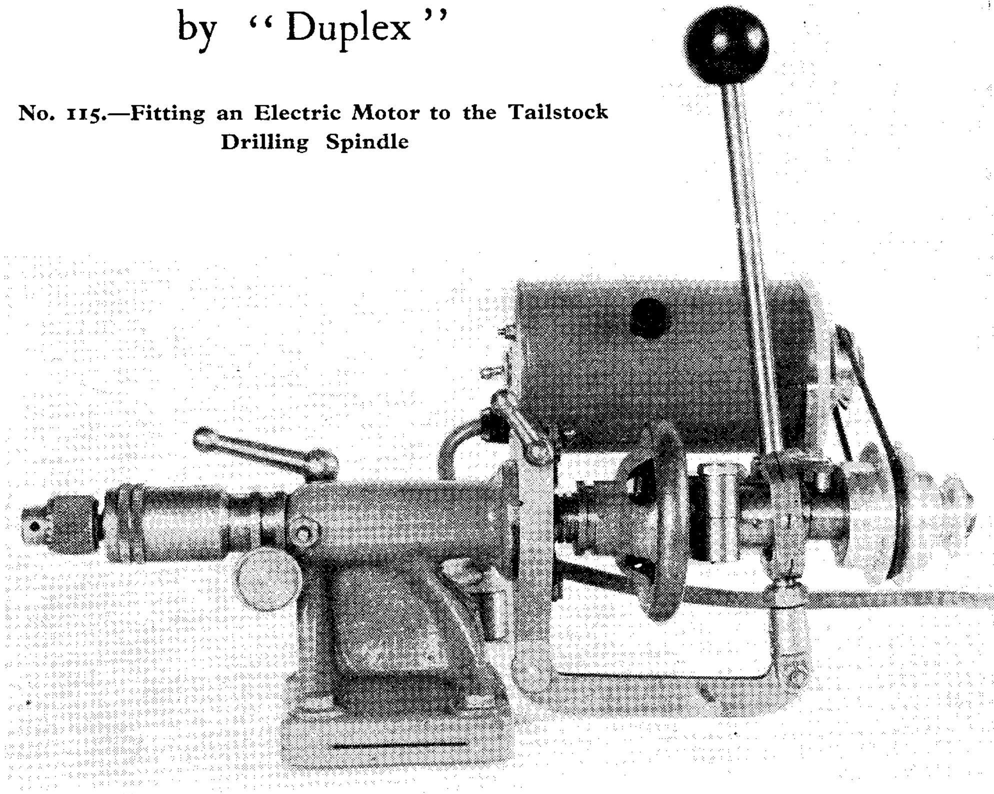


Fig. 1. The tailstock complete with its motor

ALTHOUGH the tailstock drilling spindle may be driven quite satisfactorily by means of an overhead countershaft or directly from a separate electric motor mounted close to the lathe itself, there is no doubt that a driving motor that forms part of and is built into the attachment offers many advantages. The complete device is illustrated in Fig. 1.

At first there was some difficulty in finding a suitable motor, for standard driving motors are all too large for the purpose. However, second-hand vacuum cleaners are often to be bought cheaply, and some of these appliances furnish motors that are quite satisfactory for the purpose ; one of these motors was finally chosen. As might be expected, the cases that enclose these motors are usually of little use because they are either too large or of the wrong shape. However, as will be seen at a later stage, it is possible, with the exercise of a little ingenuity, to contrive a workmanlike and presentable protective case for the motor from such unpromising material as a discarded cocoa-tin.

Small vacuum cleaner motors are usually series wound machines, for this form of winding allows the machine to run on either direct or alternating current. The motor is provided with a commutator and brushes ; in this connection, it is worthwhile remembering that a machine of this type can cause severe radio interference if steps are not taken to suppress it.

The Mounting for the Motor

When devising a motor mounting, the possibility of using the motor in conjunction with other machine tools was borne in mind. Accordingly, it was decided that the mounting should be of a simple kind that would allow the motor to be put in place quickly. As will be seen from the illustration (Fig. 2), the end-plate of the motor is provided with an attachment sleeve that can slide over a $\frac{3}{8}$ in. dia. pin attached to the tailstock. The sleeve is machined from a short length of mild-steel and has a forked lug that serves to hold the triangular plate used for attaching the sleeve to the motor end-plate. These parts, together with the tailstock adapter fittings, are depicted in the illustration (Fig. 3), whilst in

Fig. 4 the working drawings for the various components are given.

Most of the work involved is of a simple nature, and comprises operations often described in these pages.

The sleeve, a component that, at first sight, may seem somewhat formidable, is readily produced by a combination of turning and filing. Moreover, as all the turning operations may be carried out at one setting with the work gripped in the four-jaw independent chuck, there is no difficulty whatever. In addition, the gap between the arms of the forked lug is a straightforward turning operation that allows the triangular attachment plate to be fitted very closely.

The work is, of course, first marked off, as this will enable the material to be set correctly in the chuck. All heavy

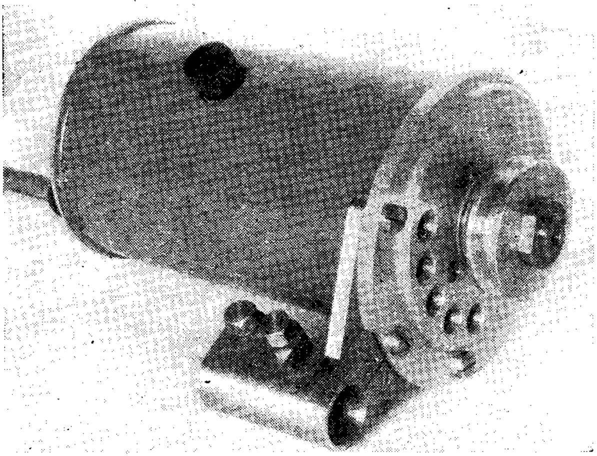


Fig. 2. The driving motor complete with mounting

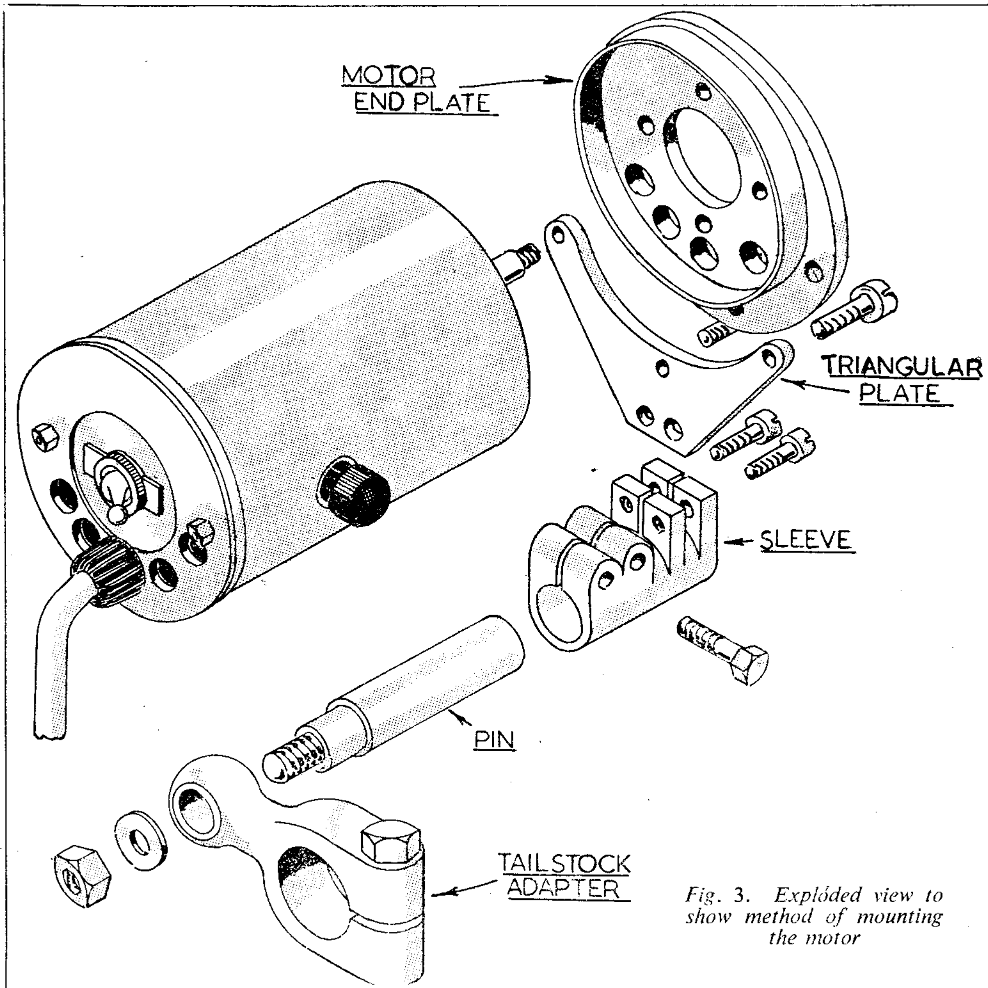


Fig. 3. Exploded view to show method of mounting the motor

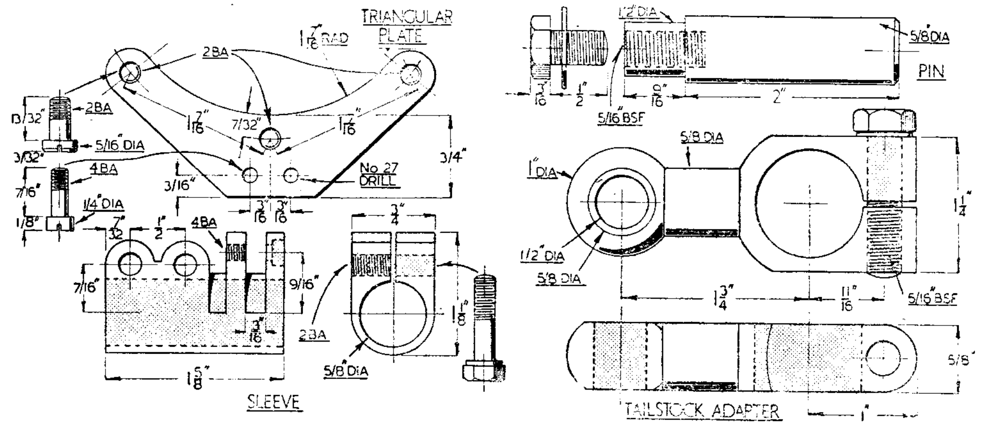


Fig. 4. Working drawings of the motor mounting

turning to shape the part should be carried out first. When this has been done, the sleeve is bored to a close fit on the tailstock adapter pin. The work is then transferred to the vice and the component is filed to shape before drilling and tapping the holes for the various securing-screws.

The saw cut that allows the sleeve to be closed on the adapter pin is best made in the power hacksaw with the vice turned at right-angles to the axis of the saw blade and with the work packed away from the standing jaw of the vice so as to bring the saw blade over the centre of the work. The method is illustrated in the sketch, Fig. 5. It will be observed that the work is set in the vice at an angle and that a mandrel made from a short length of material is passed through the bore of the sleeve. This mandrel prevents the work coming loose in the vice when the saw has finished its cut. It should be noted that the saw is not allowed to cut completely

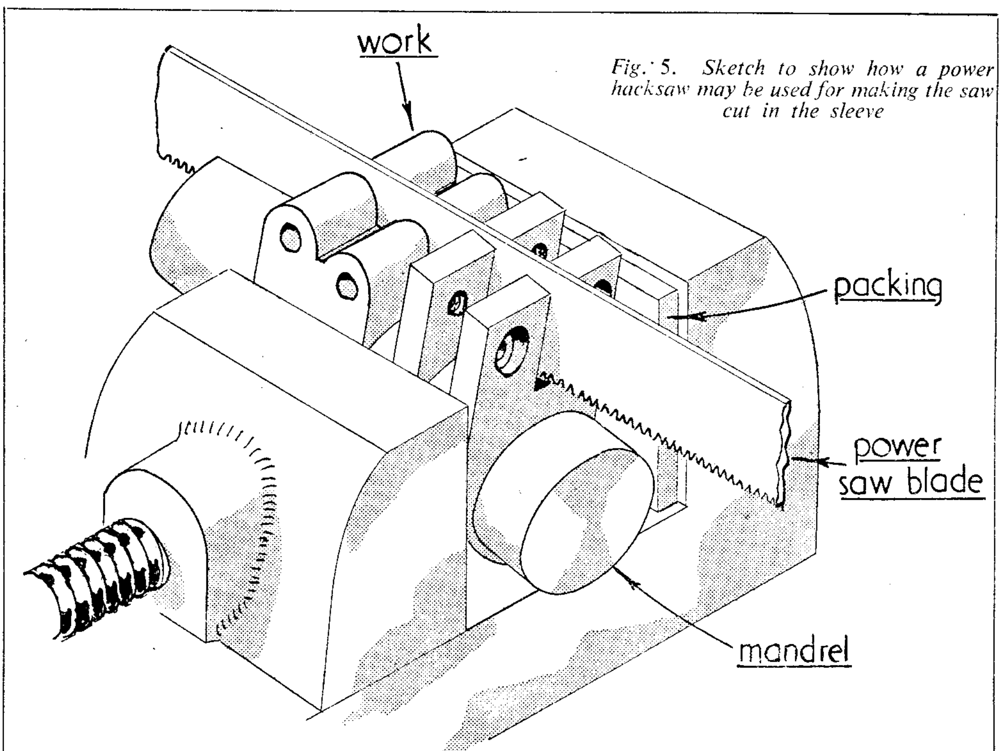


Fig. 5. Sketch to show how a power hacksaw may be used for making the saw cut in the sleeve

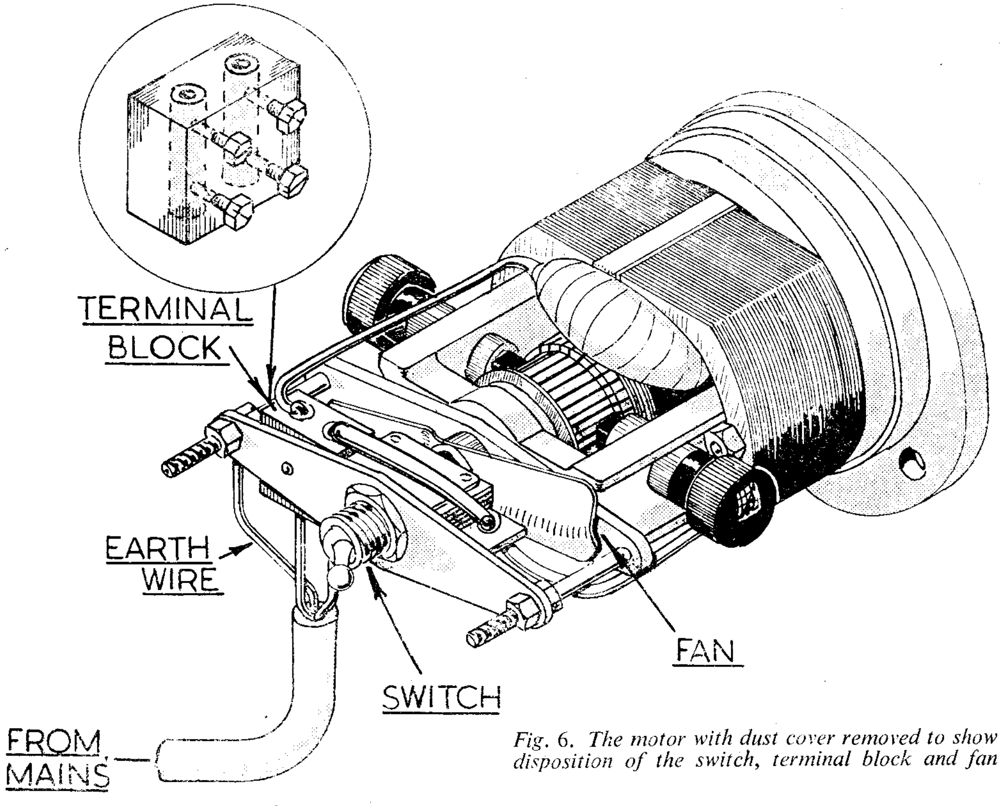


Fig. 6. The motor with dust cover removed to show disposition of the switch, terminal block and fan

through the sleeve ; the cut is stopped, leaving sufficient metal in the front lug to ensure that the two screw holes will retain their centre distances when the sleeve is closed on the tail-stock adapter pin. We have recently been asked to describe in detail the ways whereby tools of our design may be used. As will doubtless be realised, in a single article this would be a somewhat laborious undertaking. It seems best, therefore, to call attention to specific applications of these tools as and when occasion arises.

The use of the power-driven hacksaw in the manner described above is a case in point. We are, ourselves, repeatedly employing the machine for work of this nature. Without it the work would have to be set up for milling ; a far more complicated method.

The form and size of the end-plates of the motor are largely controlled by the dimensions of the tin cover that must be made for the motor itself. It will, therefore, be well to consider some aspects of this part of the work. As has already been said, a most serviceable dust cover may be contrived from a discarded cocoa tin. The tin chosen should be approximately $\frac{1}{8}$ in. larger in diameter than the motor itself. If the tin chosen is too large there will be difficulty in arranging the brush gear so that the brushes themselves may be withdrawn for cleaning without removing the dust cover from the motor.

Perhaps at this stage it will be well to emphasise that, as may be clear from the illustrations, vacuum cleaner motors of the type used in this instance are of skeleton construction and consist of little more than a pair of bearing castings to support the armature, together with the necessary stampings for the pole-pieces. The stampings are clamped between the two castings and the whole forms the carcase of the machine. When used in the cleaner, the motor is secured by means of the front bearing casting that is attached to a mounting inside the cleaner itself.

In order to house such a motor effectively when applying the machine for the purpose now being described it is necessary to provide a pair of end-plates to support the dust cover. The front end-plate forms the main anchorage for the motor whilst the rear plate serves to accommodate the motor switch and a plastic bush for the electric cable.

The rear end-plate is secured in place by two 5-B.A. studs fastened to a steel cross member that forms a mounting for the terminal block, and also for the body of the control switch. These details are illustrated in Fig. 6 where the motor is seen with the dust cover removed.

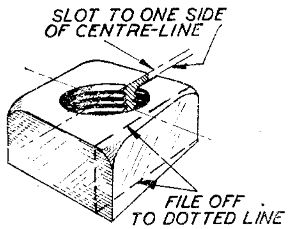
The end-plates are provided with ventilation holes and the armature is furnished with a simple axial fan to promote a current of air through the motor for cooling purposes. The driving end-plate should be made first, as its presence is essential when determining the length of the dust cover.

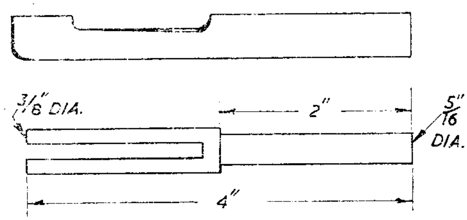
(To be continued)

HOW TO MAKE THREAD CHASERS

by C. Gaunt

MANY screw-cutting operations require the use of a thread chaser for finishing the thread to correct form, and these are very expensive to buy, but I have found them very easy to make and inexpensive if one can obtain suitable scrap steel. I make use of steel from worn out spades, which are obtained without difficulty from the local scrap yard, or if you live in the country, as I do, a visit to the village dump will usually provide the necessary material.





The steel should, first of all be annealed, which is usually done in the kitchen fire by heating it till it is red hot and allowing it to cool slightly in the ashes. It can then be cut up into pieces about 4 in. long by $\frac{3}{8}$ in. wide.

The thickness is usually about 3/32 in., which is sufficient for most small chasers.

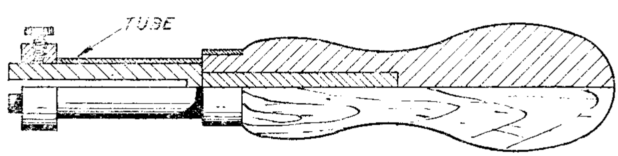
If any square nuts of a suitable pitch to suit the chaser required are available, these can be utilised, but if not, short ends of flat bar $\frac{1}{4}$ in. or $\frac{5}{16}$ in. thick can be drilled and tapped near the ends ; but assuming that a nut is obtained, a line should be scribed exactly across the centre and a slot on one side of this line is then cut through the nut, thick enough to take the steel strips. The end of a strip of steel should then be bevelled, and put into the slot, allowing it to project slightly past the thread.

The nut or bar is then screwed up tightly in the vice and a taper tap run through the hole ; this will produce a perfectly good external chaser.

For an internal chaser, a clearance gap is filed in the side of the strip ; it is held side-ways in the nut and dealt with as before.

To temper the chasers, I use the domestic washing-up basin, with about $\frac{3}{4}$ in. water in it. The chaser is heated to a bright red and the threaded end plunged straight into the water vertically till it has cooled down to a black : it is then dropped flat in the water. This leaves the cutting edge dead hard, and it must then be tempered by polishing the surface and holding on a piece of hot iron or over a spirit lamp until the end turns to a very pale straw colour.

A suitable handle to hold the chasers can be made as follows : a piece of $\frac{3}{8}$ in. diameter mild-steel is turned down to $\frac{5}{16}$ in. for a length of 2 in. from one end, the other end being slotted to the thickness of the tools for a length of $1\frac{3}{8}$ in. The collar is then made $\frac{3}{4}$ in. outside diameter $\times$ $\frac{3}{8}$ in. bore, and a hole drilled and tapped for a set-screw. The handle may be turned from wood, 4 in. long bored $\frac{1}{4}$ in. diameter to a depth of 2 in. to press on to the shank of the holder, and a piece of $\frac{3}{8}$ in. inside diameter tube slipped on to the handle to locate the collar near the front end. This will hold the chaser quite securely and at the same time make it very easy to change the tools at short notice.



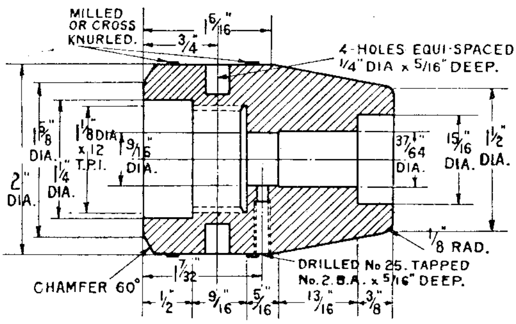
I have made a good number of these chasers at various times, and they cut quite efficiently, probably better for model engineering purposes than the comparatively heavy and clumsy commercial article.

I use old spades for quite a number of purposes which may interest readers of THE MODEL ENGINEER, including milling cutters. Another very suitable material for this purpose is that from broken springs of road vehicles, and old valve springs, straightened out, provide material for cutters as used in boring bars and similar purposes.

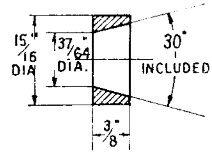
A Drawbar-Type Collet Chuck
Suitable for the Myford M.L.7 Lathe
by Stuart W. Blackley

As I was requiring a collet chuck for my M.L.7 and found that a drawbar type was just not to be had, I decided to make one myself, and so designed the following, which can be completely machined on the aforesaid lathe.

This type of collet chuck allows up to $\frac{3}{8}$ in. dia. through the chuck and drawbar and by the use of stepped-out collets up to $\frac{1}{2}$ in. dia., can be gripped. It also has the advantage that the collet gripping length is supported right up to the front by the chuck body; there is practically no collet protruding out of the mouth of the chuck, so allowing the shortest component to be firmly gripped.



CHUCK BODY CAST-IRON:



CHUCK BEARING RING SILVER-STEEL

Drawbar Tube. Stock size bright drawn mild-steel tube, $\frac{9}{16}$ in. o.d. × $\frac{7}{16}$ in. i.d. Grip tube in chuck with, say, 2 in. protruding and true up. Face and form 60 deg. chamfer in mouth of hole for centre. Reverse tube in chuck and true up along the protruding length again. Face to $13\frac{7}{8}$ in. overall length and bore to 0.451 in. dia. × $\frac{9}{16}$ in. deep and screwcut 26 t.p.i. If you have a $\frac{1}{2}$ in. × 26 t.p.i. tap, just use it to clean out the thread after you have screwcut. By screwcutting, you will get an accurate thread. Now turn up and screwcut in the chuck a stub mandrel to fit the thread in the tube and screw same on to it. By rotating the lathe, the straightness of the rube can be checked. This type of tube is usually very straight but if you find there is a slight twist, then mark the high places, screw off the mandrel and straighten, then put back on again to recheck and so repeat until dead straight for entire length. Do not attempt to straighten on the mandrel, as you will only succeed in distorting the threads.

Tube End.— 1-in. dia. mild-steel × $3\frac{1}{2}$ in. long. Grip bar true in chuck, face, bore $\frac{9}{16}$ in. dia. hole, making this about 0.004 in. larger than the o.d. of the tube, turn $\frac{3}{4}$ in. dia. × $\frac{7}{16}$ in. long and also $\frac{7}{8}$ in. dia. × $1\frac{1}{4}$ in. long. Reverse, face to $3\frac{7}{16}$ in. overall length and silver-solder or braze on to tube in the position indicated on the drawing of tube end, roughing-out sizes. The play between the tube and end-piece will allow the silver-solder to flow right through the entire length. This is a necessity.

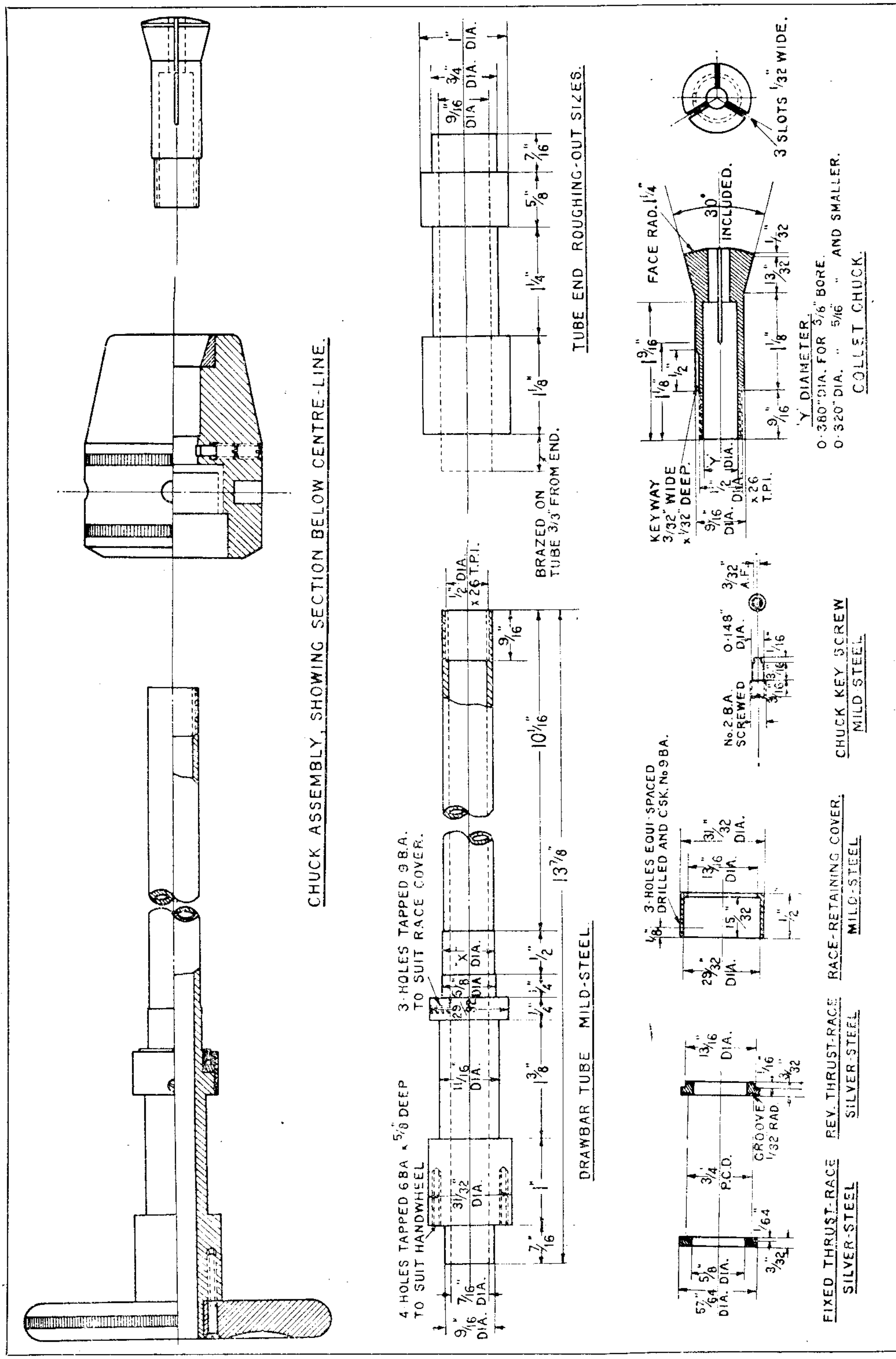
After ensuring that the chamfer in the tube is free from scale, screw on to the mandrel in the chuck and check for straightness. Support by the tailstock centre and machine tube end-piece. Touch up tube $\frac{9}{16}$ in. o.d. × $\frac{7}{16}$ in. long for handwheel, turn 31/32 in. dia. × 1 in. long and $\frac{11}{16}$ in. dia. × $1\frac{3}{8}$ in. long, also 29/32 in. dia. × $\frac{1}{4}$ in. long and $\frac{5}{8}$ in. dia. × $\frac{1}{4}$ in. long. Now, diameter x in. on drawing is the diameter of the hole in the extreme end of the spindle on the lathe, and on checking this you will find that it runs true. If it is rather rough, it can be touched out with an expanding reamer, or a scraper at a pinch. This hole is approx. 0.600 in. diameter and the tube end will have to be turned to a good fit in it, as this is the drawbar locating diameter.

Handwheel.—Aluminium $3\frac{1}{2}$ in. dia. × $\frac{1}{2}$ in. long. Grip in chuck, face, bore $\frac{9}{16}$ in. dia. hole approx. 0.0015 in. tight to $\frac{9}{16}$ in. dia. × $\frac{7}{16}$ in. long portion on tube. Remove from chuck. Turn up mandrel $\frac{9}{16}$ in. dia. with a large shoulder and press handwheel on same. Turn $3\frac{1}{2}$ in. dia., face to $\frac{7}{16}$ in. overall width and form radius on o.d.; also, 1 in. radius, giving $1\frac{1}{8}$ in. dia. boss and mill or cross-knurl o.d. for handgrip. Remove, mark off and drill No. 33 dia. holes, 4 off; also, countersink. Tap or shrink on to drawbar tube, as indicated on drawing. With a No. 43 drill, continue down the holes and tap 6 B.A., then fit in 6 B.A. × $\frac{3}{8}$ in. long countersunk screws. (Steel ones.)

Thrust-races. (*Fixed.*)—Silver-steel 1 in. dia. Grip in chuck, face, turn 57/64 in. o.d., bore $\frac{5}{8}$ in. dia. hole a press fit for $\frac{5}{8}$ in. dia. on tube and part off 3/32 in. plus.

(*Revolving*).—Face, turn 57/64 in. o.d. and $\frac{13}{16}$ in. dia. step × $\frac{1}{16}$ in. long, bore $\frac{5}{8}$ in. dia. hole approx. 0.004 in. clear of $\frac{5}{8}$ in. dia. on tube and part off 5/32 in. plus.

Both Races.—Turn up mandrel in chuck to hold races. Place on, and face up in turn both

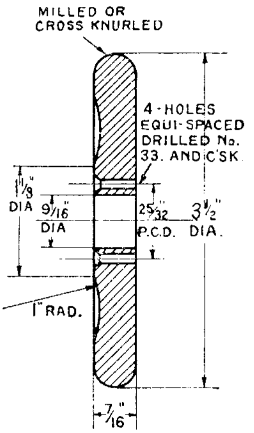

CHUCK ASSEMBLY, SHOWING SECTION BELOW CENTRE-LINE.
4 HOLES TAPPED 6 BA × 5/8" DEEP TO SUIT HANDWHEEL
3 HOLES TAPPED 9 B.A. TO SUIT RACE COVER.
BRAZED ON TUBE 3/4" FROM END.
DRAWBAR TUBE MILD-STEEL
TUBE END ROUGHING-OUT SIZES.
FACE RAD. 1 1/4"
30° INCLUDED.
3 SLOTS 1/32" WIDE.
KEYWAY 3/32" WIDE × 1/32" DEEP.
'Y' DIAMETER
0·380" DIA. FOR 3/16" BORE.
0·320" DIA. " 5/16" " AND SMALLER.
COLLET CHUCK.
No. 2 B.A. SCREWED
CHUCK KEY SCREW MILD STEEL
3 HOLES EQUI-SPACED DRILLED AND C'SK. No. 9 BA.
RACE-RETAINING COVER. MILD-STEEL
GROOVE 1/32" RAD.
REV. THRUST-RACE SILVER-STEEL
FIXED THRUST-RACE SILVER-STEEL

races. Set a 1/32 in. radius grooving tool for balls in position, giving $\frac{3}{4}$ in. p.c.d. and lock cross-slide, then form 1/64 in. deep groove in face of each race in turn without moving position of tool. Remove from mandrel. Heat to cherry-red and quench, then draw back to medium straw colour, and requench. Polish in lathe.

Thrust-race Balls.—Hardened steel balls (stock size), 32 off. $\frac{1}{16}$ in. diameter.

Race-retaining Cover.—Mild-steel, brass, or aluminium, 1 in. dia. Grip in chuck, face, turn 31/32 in. dia., bore 29/32 in. dia. hole and $\frac{13}{16}$ in. dia. hole × 1/32 in. deep. $\frac{13}{16}$ in. dia. hole to be, say, 0.004 in. clear of $\frac{13}{16}$ in. dia. on revolving race. Part off to $\frac{1}{2}$ in. overall length. Mark off and drill three holes equally spaced and countersink for No. 9 B.A. screws.

Assemble thrust-race on drawbar and then drill through the holes in the retaining cover and tap same No. 9 B.A. for countersunk steel screws × $\frac{3}{16}$ in. long. Remove cover, clean race, pack with light grease and re-assemble.



DRAWBAR HANDWHEEL
ALUMINIUM

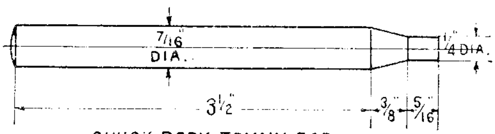
Body. — Cast-iron billet. Grip in chuck, face, rough turn 2 in. o.d. up to chuck jaws and pierce right through with 17/32 in. drill. Bore $1\frac{1}{4}$ in. dia. × $\frac{1}{2}$ in. deep to suit spigot on mandrel nose. It is important that this should be a perfect fit. Bore 1.019 in. dia. hole × $\frac{9}{16}$ in. deep and form recess at back, screwcut 12 t.p.i. to suit mandrel nose. Chamfer o.d. corner at 60 deg. down to $1\frac{3}{4}$ in. dia. Remove from chuck and screw on mandrel nose. Face to $2\frac{9}{16}$ in. overall length, taper turn o.d. down to $1\frac{1}{2}$ in. dia. at nose, finish turn 2 in. dia., and form $\frac{1}{8}$ in. radius on corner. Mill or cross-knurl as on drawing. Bore $\frac{15}{16}$ in. dia. hole × $\frac{3}{8}$ in. deep, also 37/64 in. dia. hole × $\frac{13}{16}$ in. deep and finish bore $\frac{9}{16}$ in. dia. hole. Remove, mark off and drill the $\frac{1}{4}$ in. dia. × $\frac{5}{16}$ in. deep tommy-bar holes; also, mark off and drill No. 25, tap No. 2 B.A. × $\frac{9}{16}$ in. deep hole for collet key.

Chuck Bearing Ring.—Silver-steel or mild-steel 1 in. dia. Grip in chuck, face, turn $\frac{15}{16}$ in. o.d. a press fit in chuck body, drill and bore out 30 deg. included taper and part off $\frac{3}{8}$ in. overall length. If silver-steel, harden and temper in same way as races. If mild-steel, heat to dull red and plunge into "Kasenit," or similar, case-hardening compound, reheat, plunge again, reheat, and quench in water. If the right temperature is observed, a glass-hard surface can be obtained without any shrinkage or distortion. Polish with fine emery and press into body. If one has a toolpost grinder available, the taper could be given a light grind out to ensure truth, but this, of course, should not be necessary if care is observed in the hardening and pressing-in operation.

Chuck Key Screw.—Mild-steel, $\frac{3}{16}$ in. dia. Grip true in chuck, face, turn 0.148 in. dia. × $\frac{1}{4}$ in. long and screw $\frac{3}{16}$ in. dia. No. 2 B.A. Part off to $\frac{7}{16}$ in. overall length. File 3/32 in. flats and case-harden by same method as used on bearing ring.

Locking-screw for Chuck Key Screw. No. 2 B.A. stock grub-screw × $\frac{1}{4}$ in. long.

Tommy-bar.—Mild-steel, $\frac{7}{16}$ in. dia. × $4\frac{1}{4}$ in. long. Grip in chuck face, turn $\frac{1}{4}$ in. dia. × $\frac{5}{16}$ in.



CHUCK BODY TOMMY BAR.
MILD-STEEL.

long a good fit in chuck body holes, form $\frac{3}{8}$ in. long taper. Reverse, face and form radius on end. Case-harden for about $1\frac{1}{2}$ in. along $\frac{1}{4}$ in. dia. end.

Collet.—Stock, $\frac{13}{16}$ in. dia.

The material that these are made from is left to the decision of the person making them. Mild-steel can be used and either left soft or case-hardened. If the latter is chosen, it is imperative that the material to be used is first normalised. This is best done by placing the billet of metal in the heart of a hot fire before retiring for the night and recovering from the ashes in the morning. By treating the material in this way, it helps greatly to ensure that there will be very little distortion by the case-hardening process at the end. If cast-steel is used, then the same precaution must be taken. Actually, some of the larger collet manufacturers use nothing else but cast steel and this is what I use. When heat-treating the finished collet, the body will have to be drawn back to medium straw colour and the screwed shank to dark blue. Bronze can be used; this has the benefit of ease in machining, also it will not mark a delicately finished job, and for this reason alone a well-known overseas machine manufacturer markets them.

Sizes ranging from $\frac{1}{8}$ in. dia. to $\frac{3}{8}$ in. dia., also $\frac{7}{16}$ in. dia. and $\frac{1}{2}$ in. dia., stepped at mouth will be required as a standard set.

Machining.—Grip the bar in the chuck, face, turn $\frac{1}{2}$ in. dia. × $\frac{9}{16}$ in. long and $\frac{9}{16}$ in. dia. × $1\frac{1}{8}$ in. along, turn 30 deg. included taper, bore *y* in. dia. hole (see drawing) × $1\frac{9}{16}$ in. deep and screwcut $\frac{1}{2}$ in. dia. × 26 t.p.i. Part off $2\frac{3}{16}$ in. long. Grip in vice on vertical slide and end-mill out the keyway 3/32 in. wide × 1/32 in. deep × $\frac{1}{2}$ in. long. Now, place collet in position in chuck body on lathe, holding by drawbar, and bore dead true the desired size of hole. Form radius on face and turn 1/32 in. long flat on extreme top of taper. Remove, mark off three equally spaced slots and cut these either by hand or holding in vice and slotting with a slitting saw running in lathe centres. Remove all sharp burrs from slots, harden, and then polish with fine emery.

It will be required to open out the hole in the change-wheel guard to 1 in. dia. to let drawbar through.

SPLIT TAPER BUSHES

by G. W. Arthur-Brand

I HAVE often heard split taper bushes defined as "useless inventions, which invariably close in on the shaft or spindle at the point of severance."

That the split taper bush does, in fact, suffer from this tendency, has been known for very many years; but then, so has the remedy, and with that applied, the S.T.B. becomes a most reliable form of bearing. Let us examine its function.

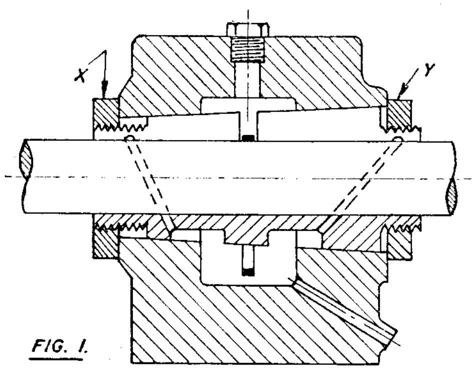


FIG. 1.

In Fig. 1 we see the usual arrangement with threaded ends and adjusting nuts, *X Y*. Should *X* at any time be over-tightened in the course of adjustment, the possibilities are that when the bush is eased, tightness will persist and the adjuster will be faced with a major crisis.

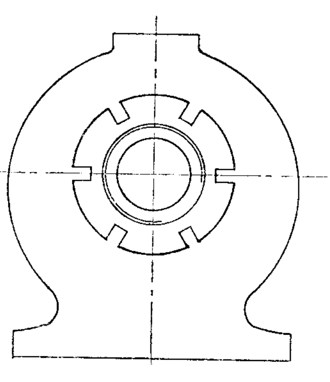
Now let us examine Fig. 2. Here we have a very similar basic arrangement to Fig. 1, the major difference being the incorporation of a locking medium which prevents the bush closing in on the spindle and thus ensuring the maintenance of a uniform fit over the entire surface of the bearing. This medium consists of a dovetailed slot running longitudinally along the top of the bush at the split, into which are fitted two dovetailed pads, usually of steel. Through the top of the housing, two holes are drilled and counterbored, and into these go two cheese-head or Allen-type screws, *Z Z*, which locate the pads through tapped holes.

It can now be seen that, after adjustment, as the screws *X X* are tightened, the action of the pads against the inclined faces of the dovetailed slot causes the split to be held apart, thus affording a positive locking of the bush at any setting.

To adjust the bearing, it is necessary only to (1) slacken the screws Z Z, (2) slacken nut *Y*, (3) tighten nut *X* until required fit is obtained, (4) re-tighten screws Z Z (5) re-tighten nut *Y*. It will, of course, be obvious that this procedure will have to be repeated, quite often several times, before the required "feel" is obtained; but it is nevertheless important to stress that the sequence of operations should at all times be completed as laid down at *each stage* of adjustment.

To keep a split taper bush "in tune," it should be run at the correct temperature (about 100-120 deg. F.), and this usually entails "warming up" for a period prior to the application of load. Another vital factor is adequate lubrication, in order to ensure the presence of a constant film of oil around the shaft. There should be no metal-to-metal contact between spindle and bearing surface.

The lubricant should be a medium oil, heavy bodied, and of such viscosity that it will not tend to run away at the working temperature already stipulated. It is also important that the oil should be clean and free from foreign bodies, and in this connection, as with the lubrication of *all* bearings, it is wise to see that it is carefully



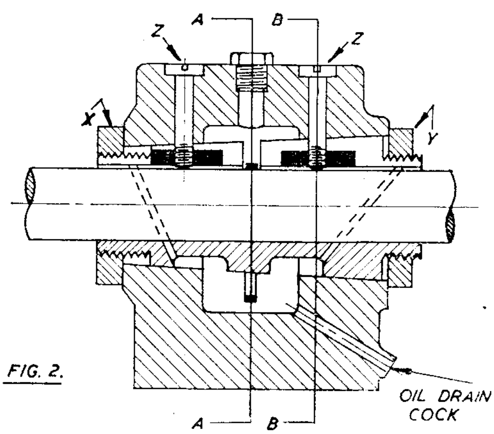
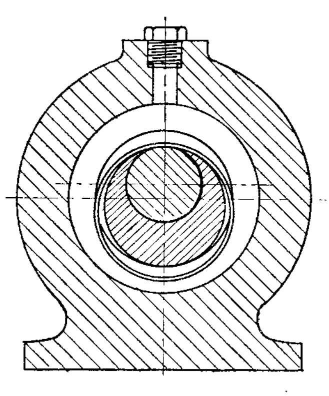
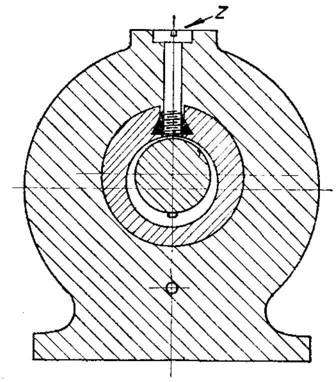


FIG. 2.



SECTION A — A



SECTION B — B

strained before use. Finally, in designing a bearing of this type, it is good practice to incorporate a drain pipe and cock so that the oil in the reservoir may be renewed from time to time, and the reservoir itself flushed through with clean fresh oil. It might be well to mention that petrol and paraffin should *never* be used for this purpose, for obvious reasons.

The Meteor Club's Grand Prix

We received a letter recently from Mr. F. G. Buck, in which he reported another successful miniature Grand Prix meeting on the Stoke circuit.

According to F.G.B., "...we had ten cars running, including the two 0.75 c.c.'s you so kindly loaned, and there was much activity the whole day from about 12 o'clock till 9 p.m.! We ran a 'knock-out' competition, running the cars in pairs over 14 laps (about ½ mile), and the final produced the most exciting and best race we have had to date. Of the two finalists, one was a direct-drive car with *no* brakes, and the other, one of my 2 : 1 geared cars *with* brakes, the effect of which was most noticeable when both cars were on the bends together.

"From the start, the geared car went into the lead by about a couple of yards, thereafter increasing the gap by not more than 2 ft. per lap, until about the ninth lap, when the other car began to get its skates on! Just before the last lap, it caught the geared car entirely by virtue of lack of brakes on the corners, and on the last lap took the lead and crossed the line barely a yard in the lead! This really was magnificent to watch, and would undoubtedly have silenced many a critic...

"We also 'had a go' at a 50-lap race between four cars, but quite frankly this was something of an anticlimax after the other race, and one of the geared cars more or less ran away with the event. That the brakes *are* working is definite, for I have slowed my two geared cars up from six seconds per lap to nine seconds, which is about the average speed of all types. By using a ½ in. longer rear plate, this was increased to ten seconds. One car was extremely light, using a plastic body and weighing about 16 oz. only. This was also fitted with brakes, and the effect was the most pronounced of all the cars so fitted. It was quickly retarded on the corners, and its acceleration down the straights was a joy to behold.

"Another thing that is becoming evident is that there is plenty for those to do who are not actually running a car. From our next meeting onwards, we shall have time-keepers recording lap times of individual cars, so that we can look out a handicap on as fair a basis as possible.

"As to the 0.75's, they started the day in quite good style, but became somewhat erratic later. However, they *did* show that there is definitely room for a small class, although I would advise builders to adhere to the existing class (1.5 c.c.) until there are enough of these to make things interesting."

This is a most interesting and instructive letter, and we publish the above excerpts in the hope that they will help and encourage those readers who are preparing to enter M.G.P.

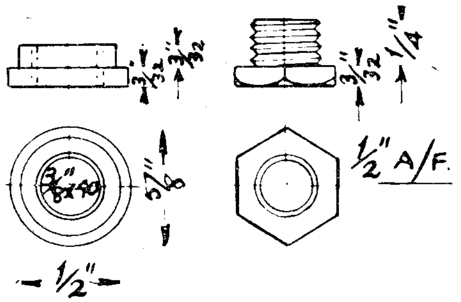
*The Allchin "M.E." Traction Engine

to $1\frac{1}{2}$-in. Scale

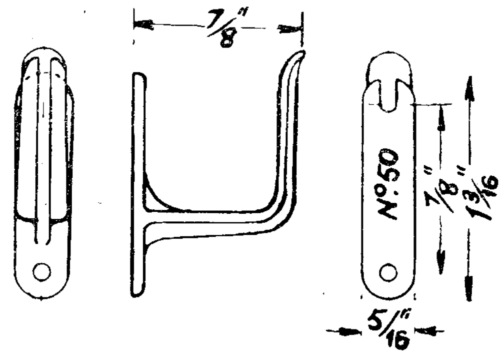
by W. J. Hughes

THE bottom of the tender is a piece of 18-gauge brass sheet $3\frac{9}{16}$ in. wide by roughly $5\frac{1}{4}$ in. long—you can get the exact length from the job itself, but it is as well to allow a little extra at both ends in case you don't get the bend exactly in the right place.

Square a line across where the centre of the bend should come, and bend it round a mandrel held in the vice, as you did the back. When it fits, trim the ends as necessary, and set out the centre for the wash-out plug $\frac{15}{16}$ in. from the front edge. Drill a $\frac{1}{2}$ in. diameter hole here.



The washout plug and nipple



Front, side, and rear elevations of the hose-brackets

Washout Plug and Nipple

Strictly speaking, the washout plug is an "added" fitting not on the prototype. The latter could have the tank cleaned out by taking off the manhole, but in our case this is a dummy, of course. We *could* have made it removable like big sister's, but it would not have been easy to have made and maintained a water-tight joint in thin sheet. So we'll fit a washout plug, which won't be seen anyway. Then if, and when, any sediment collects in the tank, the plug can be removed, and a stream of water directed through the filling-pocket to clean out the tank.

To make the nipple, chuck a piece of $\frac{5}{8}$ in. diameter brass or bronze rod. Face the end, centre it, and drill and tap $\frac{3}{8}$ in. × 40. Turn a shoulder $\frac{1}{2}$ in. diameter by 3/32 in. long, and part off at 3/32 in. from the shoulder. Silver-solder the nipple into the tank-bottom.

For the plug, chuck a piece of $\frac{1}{2}$ in. hexagon brass, face the end, and turn to $\frac{3}{8}$ in. diameter for a length of $\frac{1}{4}$ in. Screw this spigot $\frac{3}{8}$ in. × 40, using the tailstock die-holder, and part off at 3/32 in. from the shoulder. Reverse in the chuck, gripping the threads lightly, and chamfer the corners. I like to use a screwed bush to hold such jobs, personally. You can make one easily by gripping an odd stub of brass rod in the chuck, facing the end, centring, and drilling and tapping $\frac{3}{8}$ in. × 40. Then the plug can be screwed into it, and so gripped without injuring the threads. Incidentally, if you make one for each similar job which crops up, you'll soon have a useful collection which can be used over and over again. Don't forget to make a centre-pop against No. 1 jaw on each bush so that it can always be put in the chuck the same way.

Fitting the Bottom

Tin the mating surfaces on the bottom and the tender-sides, and rivet the bottom in place, not forgetting to rivet it to the patch-piece we added to the bottom of the back. The joints may then be sweated over inside, as before.

Incidentally, it may be as well to try the front plate of the tank in position with the bottom in place, before finally riveting and sweating the latter. Then if any adjustments *are* necessary, they can be done more easily.

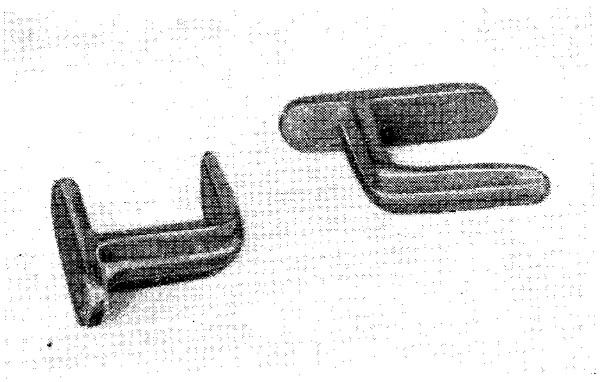
When the tank bottom is finally fixed, it will be as well to test for leaks before fitting the front, as although any that may appear *could* be sweated over from outside, it will be neater to do them from inside.

Plug the holes in the footplate with wooden plugs, and likewise the one in the water-lifter elbow. That in the filling-pocket may also be filled with wood, but a better method, since the shape is awkward, is to plug the pocket with rag, with an outer layer of plasticine (which can often be useful in the workshop, but the way ; e.g.,

*Continued from page 519, "M.E.," April 17, 1952.

to fix a screw to a screwdriver for insertion in an awkward place).

Now stand the tender up on end, and fill the tank with water. Leave it for a time, and if any dribbles appear, take the necessary measures after emptying out the water. But don't forget to wash out well any acid flux that is used!



Photograph No. 7. Castings for the hose-brackets, in malleable iron, before cleaning-up and drilling

Fitting the Tank Front

The flanges of the tank front having been tinned, it can be wangled into position and fastened with toolmaker's clamps. Tip: if you drill a small hole in the centre of each flange, you'll find the wangling much easier! You can then bend the end of a bit of stiff wire at right-angles, and push or pull the plate about by sticking the bent end into one or other of the holes. Otherwise there's nothing to get hold of.

With the plate clamped in place, insert the rivets and sweat the joints. If there are any small gaps in the corners, the solder will run through, so drive in small scraps of brass or copper and solder over these.

Wash well out again with water, in case any flux has run inside, and then test for leaks as before, but this time with the fotoplate horizontal. Use a fibre or hallite washer on the washout plug, by the way.

Hose Brackets

Brother Reeves has some delightful little castings for the hose-brackets, and at the extremely moderate price I don't think they are worth making. However, some people prefer to make as many bits and pieces as possible, and if so they could be built up in brass by silver-soldering the bracket to the backplate, and then sweating the strengthening web in position. All edges should be rounded slightly.

Castings should be cleaned up with files, the backplates being filed flat and straight. Fixing holes are drilled No. 50, and the upper ones elongated into slots, as in the prototype (*see* Photograph No. 2 and drawing herewith).

On the right-hand tender-side, drill a No. 50 hole $\frac{7}{8}$ in. from the back curve and $2\frac{9}{16}$ in. above the central line of rivets. A second hole is drilled 2 in. away from and level with the first: these are the upper holes for fixing the brackets. Through these scribe lightly the centre-lines for the brackets—you can find these from the dimensions given in the drawing (second instalment).

Clamp a bracket in place with a 10-B.A. screw and nut, and through its lower hole drill the fixing hole in the tender-side. Insert a second 10-B.A. screw and nut—hexagon head with the nuts outside—and then similarly fix second bracket.

Lamp Bracket

The bracket for the rear lamp is simply a strip of 20-g. steel—preferably unhardened spring steel —$1\frac{3}{8}$ in. long by $\frac{3}{16}$ in. wide. One end is rounded with a file, and the strip riveted in place with two 3/64-in. rivets, or a couple of large domestic pins. The other end is then bent up round a piece of $\frac{1}{4}$ in. diameter rod. See third instalment for drawing of this fitting in the rear elevation of the tender.

Half-round Beading

The $\frac{3}{16}$-in. half-round beading is best fixed in short lengths, butted up to one another, and it will be as well to start with the door opening first.

It is not a difficult matter to bend the beading on edge, provided it is well annealed, and that patience is used. For the first piece, grip a length of $\frac{5}{8}$ in. diameter bar in the vice, and bend the beading round that. You will find that it twists sideways, and from time to time it will be necessary to tap it flat. Anneal as necessary, and keep trying it in position at the front edge of the opening.

When it fits the curve properly, cut it off at the front and file the end—not quite square, be it noted, because of the slope of the tender-top. Then cut it off about halfway down the door-opening, and file that end square. Tin the back of the beading, and where it is to fit—in fact, you can tin all round the edge of the tender top —and sweat it into place, holding it *pro tem* with the ever-useful toolmaker's clamps. (The humble "bulldog" clip is not to be despised on such work, either.)

Bend a second piece round a mandrel of $\frac{3}{8}$ in. diameter rod, fit it up to the first piece, and cut it off about half-way along the bottom of the opening. File the end square, and sweat this piece in place. Tip: place a cloth soaked in cold water over the first piece so that you don't unsweat this.

The third piece is then bent and butted up to the second in the same way; it can fit right to the top, being mitred at this corner. After sweating it in place, finish filing the door opening flush with the edge of the beading—you will recall that we didn't file to the line originally.

To fit the remainder of the beading round the top edge of the tender is an easy proceeding, and need not be detailed here; the same applies to the piece which is fitted to the top edge of the coal plate.

Tender Now Completed

And having completed that little job, you will be justified in lighting a gasper or the old pipe, and standing back to admire your tender, all complete at last, except for what might be termed the loose fittings, such as the waterlifter, injector, and suction pipes. I don't know how you feel about these things, but when I've finished some particular part of a job, I take a keen delight in just *contemplating* it for a time, thinking, perhaps ; " H'm, *this* little bit could be better," or " Well, I feel quite pleased with *that* little bit."

Maybe the really practical man will think that a waste of time, but, of course, to some folks *all model* engineering is a waste of time ! I remember some time ago being asked by a friend, who is an ardent football fan, what *good* model engineering did me. Before I could reply, however, another friend countered : " What good does it do *you* to stand watching twenty-two grown men kicking a chunk of leather about a muddy field ? " And then, before number one could reply to that, number two continued ; " . . . And what's more, what have you to show for it ? Old Bill here . . . " (which is the disrespectful way in which many of my friends refer to me) ; " . . . old Bill *has* got something to look at when he's finished ! "

However, let's cease these musings. The next instalment will start with the hornplates, and there'll be " farsands " of holes to drill, so see that the machine is in good order, won't you ?

(To be continued)

PRACTICAL LETTERS

The " Sentinel " Wagon

DEAR SIR,—I was interested in Mr. W. Boddy's recent article on Steam Wagons.

I should like to point out, however, that the Sentinel of 1924, with differential in the crankshaft, would be the famous " Super Sentinel " which had cylinders $6\frac{3}{4}$ in. × 9 in., not $6\frac{3}{4}$ in. × 10 in. as stated. This machine was rated as a 6-tonner, but was also available as a 10-ton articulated 6-wheeler.

The shaft-drive " Sentinels " still used by the Gas Light & Coke Co., are the " S " pattern, and were the final design. The engine of this machine has four single-acting cylinders and develops 120 b.h.p.

Four-, six- and eight-wheeled vehicles were made in this design. Between the " Super " and the " S " came the " D.G." similar to the " Super," but as the name implies, the engine was double geared.

The high tax imposed under new regulations of about 1932, was the main cause of the death of the steam wagon, as I believe " L.B.S.C." mentioned in an article sometime ago, no doubt had it not been for this we should still see a considerable number of steamers on the road.

Yours faithfully,

Edgware. G. F. A. GILBERT.

Any Suggestions ?

DEAR SIR,—Advice is sought upon the following points :

(1) What is the best method of securing the head of a club hammer to the handle ? The considerable belling of the hole through the head makes it very difficult to secure by conventional wedges.

(2) What is the best solvent of oxidised mineral oil ? I have found paint stripper to be much better than paraffin for this purpose, but it contains wax, which I think is undesirable on a machine tool, and is rather expensive.

(3) What is the correct peripheral speed of a circular India stone ?

Yours faithfully,

Purley. T. NORMAN GILBERT.

Atmospheric and Other Engines

DEAR SIR,—I have read with great pleasure B.C.J.'s article on Atmopsheric Engines. I thoroughly agree that in models of old engines, use should be made of the original materials, or if this is not possible, the material should be made to look correct. In the case of the Newcomen engine, however, if this is intended as a model of an engine erected by Newcomen, the cylinder should certainly *not* be of iron, but some form of brass or gunmetal. Smeaton was the first engineer to take advantage of the progress made in iron founding, in his modifications of the Newcomen engine during the latter half of the eighteenth century.

The picture of the Otto and Langen engine revives memories of my boyhood. There was one in occasional use within a few hundred yards of my home and it was not finally scrapped until about 1919. It was a most fascinating engine to watch, especially when running light. It then made only three explosions per minute. During the intervals the flywheels revolved with no other sound than a slight ticking from the free-wheel, then a sudden " clock " would be heard as the governors let in a pawl, which started the side shaft. Then pandemonium broke loose, in the midst of which the rack could be seen flying skywards, followed rapidly by the quieter rumble as the piston descended again, then almost complete silence again, the whole cycle of operation taking only about 4 to 5 sec. The engine was, I believe, a slightly later model than that shown, having an even more massive cylinder casting. These engines were interesting as showing what a comparatively high thermal efficiency can be attained in a non-compression engine, if a long range of expansion, and, therefore, large temperature drop is employed. These engines had a gas consumption per b.h.p. hour of under 40 cu. ft. against the 100 cu. ft. of the earlier Lenoir engines. Indicator cards had much the appearance of a high compression engine, with the atmospheric line displaced.

The connecting-rods of the Lowne engine mentioned later always intrigued me, as being one of the only cases known to me where the connecting-rod is always in tension, and can,

therefore, be made as a tie-rod and not a strut; the angularity of its pull on the piston was also much reduced by the joint in the upper-end, where it connected with the rocking lever.

"That Wonderful Year . . ."

I have also greatly enjoyed reading the articles by "The Dominie" on the engines of 1851. The horizontal engine in Fig. 47 is a pleasant memory of my youth, as there was one driving a grist mill in my home town. It carried on the steam chest cover the name Barton and Stearn (a local firm) but as I had, as a small boy, an old copy of Bourne with the identical picture given in THE MODEL ENGINEER article, and attributed there to Ransomes, I always regarded it as a product of the Ipswich firm. I may say that this picture is a most accurate representation of the original, as I carefully checked it forty years ago with the assistance of the foreman miller, who told me of slight detail alterations made within his memory, which corresponded with slight deviations from the drawing. By the way, if anyone is thinking of making a model of this engine, a detail not visible in the drawing was a chain drive to the governor, an ordinary link chain on pulleys like a Weston block. This type of drive was not uncommon, I believe, in the middle nineteenth century.

One query I should like to make about the engine said to be by E. R. & F. Turner, Fig. 46. I have several copies of this drawing, and in every case it is attributed to Barrett Exall & Andrews of Reading, and has many of the characteristics of the Reading firm, but none that I can see of Turner's, and I was rather familiar with Turner's engines, being Suffolk born.

Another query of this sort is the oscillating engine in Fig. 39. "The Dominie" attributes this to Clayton & Shuttleworth, but I have a similar picture attributed to Penn of Greenwich. I think here that the Lincolnshire origin is the more likely, but would like confirmation of it if possible.

I must apologise for the length of this letter, though there are many other points of interest I should like to have mentioned, not only from these most interesting articles, but also from other equally interesting matters dealt with in THE MODEL ENGINEER.

Yours faithfully,
Norwich. GEOFFREY K. KING.

Liquid Gas Torches

DEAR SIR,—With reference to Mr. H. C. Gilson's letter in a recent issue and his request for information on torches using liquid gas and pressurised air; he will find such a torch described in a booklet published by the Liquid Gas Dept. of the Shell Petroleum Co. Ltd., Shell Court, White Kennet Street, London, E.1. The booklet is titled "Liquid Gas," by L. A. Peletier and is a reprint of a paper read by the author before the Royal Dutch Institute of Engineers.

Yours faithfully,
Banstead. A. R. TURPIN.

CLUB ANNOUNCEMENTS

The Society of Model and Experimental Engineers

There was a most successful track meeting at Wanless Road on April 26th. The weather was fine and there was a good attendance of members and visitors. Two tracks were in operation, the North London Society having kindly loaned their track for the occasion. Amongst the visitors we were glad to see Mr. Messer, of the South Australian Society, and Mr. Palmer, of the Durban Society of South Africa. A number of "learner" drivers were initiated, including a capable young lady.

There will be a rummage sale at headquarters on Saturday, May 17th, at 2.30 p.m. All lots for sale must be entered by this time.

Full particulars and application forms may be obtained from the Secretary, E. C. YALDEN, 31, Longdon Wood, Keston, Kent.

The Bristol Society of Model and Experimental Engineers

Mr. Watts has resigned the secretaryship of this society, and the office has been taken over by the former assistant secretary, Mr. H. W. Woodward, of 18, Stanley Avenue, Bishopston, Bristol, 7, to whom all future communications should be addressed.

On April 16th, members attended a very interesting talk entitled "Foundry Practice for the Amateur" given by Mr. Hayward. With the help of the epidiascope, he described different methods used for casting various metals and was able to give some useful hints to those who might wish to try making their own castings at home with the minimum of equipment.

On April 19th the society went on a visit to Sudbrooke pumping station where members were able to see Cornish pumping engines at work pumping water out of the Severn tunnel. They were ably shown round the station by Mr. Stephens, who also demonstrated the intricate working of the Cornish engine on the scale model which he himself had made of one of the engines.

The engines have been working since the completion of the tunnel in 1886 and pump out over 10,000,000 gallons of water daily. Members also saw the ventilating fan at work which is driven by a tandem steam engine. The fan is 27 ft. in diameter and delivers 800,000 cu. ft of air to the centre of the tunnel every minute.

This visit has impressed on members the magnitude of the task which must have faced the engineers in constructing the longest underwater railway tunnel in the world and they are grateful to British Railways (Western Region) for making the visit possible.

Whitchurch (Glam.) and District Model Engineering Society

Continuing the winter programme of talks and discussions, a film show was recently given to members in the Y.M.C.A. by the Aims of Industry Organisation including items on the steel, pottery and automobile industries. More recently still, a talk was given by a club member, Mr. T. Whitaker, on his visit to the Oxford M.E. Society, completed by a series of very fine photographs of their last exhibition and members' models, which were very kindly loaned by the Oxford Society. We all hope that the contact now established will be continued.

Meeting nights of our society are Mondays and Thursdays, and anyone wishing to join will be welcome at the workshop, rear 36, Moy Road, Roath, Cardiff, on either of these nights, or they may contact the Hon. Secretary, W. D. HARRIS 177, Whitchurch Road, Gabalfa, Cardiff.